UNIVERSITY OF NATAL

PIETERMARITZBURG
SOUTH AFRICA

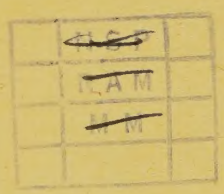
WATTLE RESEARCH INSTITUTE

South African Wattle Growers' Union — University of Natal —
Union Department of Forestry

REPORT FOR 1960–1961

(FOURTEENTH YEAR)

OCTOBER, 1961



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COMMITTEE OF CONTROL OF THE INSTITUTE

Appointed by the South African Wattle Growers' Union (3):

Major C. J. J. Crowe (*Vice-Chairman*).
S. J. F. Nuss, Esq. (*Resigned November*, 1960).
T. F. Mackenzie, Esq.
H. F. C. Kusel, Esq. (*Appointed November*, 1960).

Appointed by the University (2):

Professor A. J. W. Bayer, D.Sc. (*Chairman*).
Principal E. G. Malherbe, M.A., Ph.D., LL.D.
Alternate: Professor E. R. Orchard, M.B.E., B.Sc., Ph.D., F.R.I.C.

Appointed by the Government Department of Forestry (2):

M. van N. Möhr, Esq., B.Sc.
J. H. van Wyk, Esq., M.Sc., M.F.

The Director:

Professor H. Shaw, M.Sc.Tech., Ph.D., F.R.I.C.

Honorary Secretary:

P. G. Leeb-du Toit, Esq., B.Com. (*Registrar, University of Natal*).

STAFF

SEPTEMBER, 1961

DIRECTOR:

H. Shaw, M.Sc.Tech., Ph.D. (Manc.), F.R.I.C.

Silviculture:

S. P. Sherry, M.A. (Oxon.), B.Sc. (South Africa).
R. J. F. J. Atkins, B.Sc.For. (Stell.).

Technical Assistants:

M. J. Lourens.
A. M. MacKenzie. (*Resigned February*, 1961).
I. S. Alexander.
P. J. D. Nicholson. (*Appointed August*, 1961).

Genetics and Plant Breeding:

A. A. Moffett, B.Sc. (Birm.), Ph.D. (Lond.).
Miss K. M. Nixon, M.Sc. (Natal).

Technical Assistant:

A. R. Field. (*Appointed March*, 1961).

Plant Physiology:

F. C. J. Zeijlemaker, D.Sc. (Amsterdam). (*Appointed January*, 1961).

Chemistry:

W. S. Martin, Ph.D., D.Sc. (Lond.), A.R.C.S., D.I.C., A.R.I.C.
C. G. Gordon-Gray, M.Sc. (Natal).

Technical Officer:

R. A. Jones.

Entomology:

Technical Officer:

G. B. Wortmann, B.Sc. (Natal).

Technical Assistant:

R. E. Thurston.

Biometry:

Administration:

Miss E. K. Smith.

Non-Europeans:

Eight.

Field Experiment Station Overseer (S.A.W.G.U.):

M. A. Stewart.

FOREWORD

The past year has been perhaps the most difficult in the Wattle Research Institute's fourteen years life. Starting under the shadow of the death of Dr. Ossowski and the consequent interruption of the work of the Entomology Section, it continued in an atmosphere of uncertainty and hesitation. With one important exception, the vacancies in the research staff remained unfilled, while powers beyond the control of the Institute decreed the end of Entomology as an integral part of the research programme. In consequence, it appears that important and highly promising investigations will be left in abeyance or even discontinued. The record of the incidence of wattle insect pests, unbroken through twelve years, has also come to an end.

On the brighter side of the picture, the appointment at long last of a plant physiologist has made it possible to open up several lines of work too long neglected. In particular, it has added a third prong to the attack on the major problem of gummosis. To the work on the effect of silvicultural practices and the efforts in the direction of plant breeding and selection has been added a new approach through an investigation of the behaviour of the plant itself designed to reveal the physiological nature and origin of the disease.

Harvesting of the Institute's first cycle of experiments has now reached peak level and all the available man-power is barely adequate for the task during the stripping season. The results are being assessed as they come to hand and will provide the basis for the next series of experiments. Already, it is clear that the major issue will be not the finding of problems, but selection from the large number demanding attention. Out of the experience so far gained, some changes of emphasis and new alignments of approach will undoubtedly emerge.

All this constitutes for the staff of the Institute an opportunity and a challenge which they hope to be able to accept, uninhibited by undue hindrance or distraction and with enthusiasm undamped by doubts and uncertainties. The whole wattle industry faces a difficult future that can be entered upon with confidence only if the industry operates at maximum efficiency and utilizes every technical and scientific resource available to it. One of the surest means to this end is acceleration of the pace and broadening of the scope of research and, not least, the prompt and determined application of its results.

H. SHAW, *Director.*

October, 1961.

ADMINISTRATIVE REPORT

BUILDINGS AND PLANTATIONS

Main Buildings.

To meet the needs of the Plant Physiologist appointed during the year, a 30′ x 12′ glasshouse has been built adjacent to the insectary behind the main building. This will be equipped with an internal mist-spray system to assist control of temperature and humidity and provision has been made for external recording of the conditions prevailing inside. General maintenance included major repairs to the central drainage gutter in the roof of the main building.

A further section of the ground in front of the building has been cleaned up and levelled and this, together with the removal of the greater part of the builders' equipment from the neighbouring site, has made possible a further improvement in the appearance of the surroundings. The eastern boundary has been fenced by the University Council, thus effectively separating the University property from the adjacent Corporation housing estate.

Field Experiment Station.

Harvesting of the original sets of experiments at Bloemendal has now reached a peak level and in the year under review, 38.2 acres were cleared. Of this area, only 7 acres were immediately laid down to new experiments, the remaining 31 acres being prepared for future experiments as required. The overall average yield was 8.4 tons per acre, slightly less than the 8.9 tons of the previous year. Some of the area consisted of special experimental material where low yields were to be expected, but this was counterbalanced by other blocks which yielded well over 9 tons per acre.

For the first time in its ten years' history, the farm showed a substantial loss over the year, but the detailed figures reveal that this arose largely from loss of revenue due to lower bark prices. It has always been regarded as a fortunate accident that for a number of years, the trading profits on the farm were more than sufficient to cover the cost of experiments which could not be expected to give a satisfactory financial return. With the fall in revenue, however, this is no longer the case and there was, in fact, a small loss on trading account.

ADMINISTRATION AND FINANCE

The only change in the personnel of the Committee of Control during the past year was the replacement of Mr. S. J. F. Nuss by Mr. H. F. C. Kusel as one of the three representatives of the South African Wattle Growers' Union. Mr. Nuss had served on the Committee for three years, but through recurrent ill-health had been unable to play a full part in its work; Mr. Kusel, though closely associated with the beginnings of the Institute, had not previously served on the Committee.

Three ordinary meetings were held during the year, at the first of which Professor A. J. W. Bayer and Major C. J. J. Crowe were re-appointed Chairman and Vice-Chairman respectively. Mr. M. van N. Möhr was again nominated as assessor member of the S.A.W.G.U. Field Experiment Station Committee.

Discussion continued between the Wattle Growers' Union and the Government in respect of an increased grant to the Institute, and two deputations, both of which included the Director, met members of the Department of Forestry. The first and larger deputation was received in November, 1960, by the Minister of Forestry, the Hon. P. O. Sauer, and the Secretary, Mr. D. R. de Wet. The representations made were received sympathetically and the Minister acknowledged the need for additional Government assistance to the Institute. The matter was referred to the Department's Research Co-ordination Committee for a recommendation. In January, Mr. T. F. Mackenzie and the Director met the Research Co-ordination Committee and, after a detailed discussion, it appeared that the Committee was prepared to recommend a pound for pound grant on approved projects. In February, however, a communication was received stating that the Government was not prepared to make any increase in the grant. At the outset of these discussions, the suggestion tentatively put forward in 1957 by the Secretary for Forestry, that the basis of the Institute's work should be broadened to include all forestry research in Natal, was rejected by the Department.

These protracted discussions, ending in the rejection of the request for additional assistance, together with the difficult financial position of the Wattle Growers' Union, inevitably had their repercussions in the Institute. The ceiling placed upon senior staff salaries well below their nominal level was maintained for a further year, but more serious than this was the general sense of uncertainty that was engendered. In such circumstances, it is almost invariably true that fears outrun actualities, but awareness of this fact is a poor substitute for positive confidence and assurance.

Another issue no less disquieting is the position of wattle entomology in relation to the Institute. Under pressure from the Department of Forestry, no appointment was made to the post left vacant by the death of Dr. Ossowski, though there were very good applicants in the field. This was done so as not to prejudice the request for an increased grant, but even when this was turned down, the Department maintained its insistence that Entomology should be discontinued as an integral part of the Institute's work and handed over to the Division of Entomology in the Department of Agricultural Technical Services. The Committee of Control and the Institute staff are convinced that this is a retrograde step, but under prevailing circumstances in the wattle industry, it cannot be resisted. Arrangements are in hand, therefore, for the Division to take over, but indications are strong that some of the most promising work in the Institute's research programme, including the bagworm virus disease studies, will have to be abandoned.

Expenditure and Income.

Although over R700 was spent on the new glasshouse, total expenditure for the year at around R56,000 was some R8,000 less than in the previous year and about R15,000 below the estimate. This is largely due to the fact that several posts, particularly in the Entomology Section, were not filled, with consequent reductions in expenditure on salaries, travelling, subsistence, and general services. A further reduction in costs arose from there being no need to replace an Institute vehicle during the year. On the other side of the account, several non-recurring special items of income arose. There was considerable refund of fares and other advance payments in respect of Dr. Ossowski's visit overseas, and certain redundant equipment was disposed of advantageously. Fees for analytical services were rather less than in recent years.

These figures reveal a situation that is in no sense an indication of healthy economy; on the contrary it is a matter for grave concern and regret. At a time when the Institute should steadily be expanding its activities and moving confidently forward into the next phase of its investigations, it is suffering a contraction forced upon it by circumstances which are only partly unavoidable.

The summarized statement of Expenditure and Income for the period 1st September, 1960, to 31st August, 1961, appears below. Detailed Accounts and Balance Sheet are published separately.

RESEARCH INSTITUTE ACCOUNT

1st September, 1960, to 31st August, 1961

Expenditure	R c	*Income*	R c
Research and Administrative Staff Salaries, etc. ..	47,443.33	S.A.W.G.U. Grant	35,663.25
Travelling and Subsistence..	1,448.68	Department of Forestry Grant	20,000.00
Laboratory and Office Equipment and Maintenance	1,970.19	Analytical Services	221.40
Library	986.44	Redundant Equipment ..	160.00
Printing and Stationery ..	618.97		
General Administration ..	1,524.19		
Building Maintenance ..	274.52		
Building Additions	778.33		
Special Provident Fund Reserve	1,000.00		
	R56,044.65		R56,044.65

STAFF

The research posts of Senior and Assistant Entomologists, Biometrician, and Assistant Silviculturist remained vacant throughout the year, but Dr. F. C. J. Zeijlemaker joined the staff in January, 1961, to fill the long-vacant post of Plant Physiologist. Dr. Zeijlemaker was born and educated in Amsterdam, Holland, and immediately before coming to the Institute had been for three years Professor of Botany at the University College of Pius XII, Roma, Basutoland. The two vacant posts of Technical Assistant were filled by Mr. A. R. Field, who joined the staff in March, and Mr. P. J. D. Nicholson, who came in August.

During the year, Mr. C. G. Gordon-Gray was granted four months long leave, which he spent in the Chemistry Department of the University of Natal on work for a Ph.D. thesis. Miss E. K. Smith was absent for two long periods of illness and some difficulty was experienced in finding a satisfactory substitute.

Mr. G. B. Wortmann, Technical Officer in the Entomology Section, was awarded a scholarship by the Deutscher Akademischer Austauschdienst to enable him to study virus technology for a year at the Bundesforschungsanstalt für Viruskrankheiten der Tiere in Tübingen, West Germany. He left at the end of August, having been granted fourteen months leave of absence.

As the Wattle Research Institute Research Scholarship has attracted little interest, it was converted for 1961 to an Undergraduate Loan Bursary. This was advertised and eventually awarded to one of the Institute's own junior staff, Mr. A. M. MacKenzie, who had an outstanding record as a part-time student in the University of Natal. He will rejoin the Institute staff on completion of his tenure of the Bursary.

Advisory.

Despite the depletion of staff during the year, the increase continued in the number of advisory letters written, though these consisted very largely of routine communications to growers in connection with bagworm assessment and control. That 372 of the 454 letters referred to insect pests reflects the continued activity of the Entomology Section in the advisory field, though operating without a research officer in charge. There was a renewed demand for Institute publications and a marked increase in requests for information on the principles of valuation (the Institute does not undertake actual valuations), survey, and age estimation. Letters answering enquiries from Natal (326) far exceeded those to other areas, though the Transvaal accounted for a large number (93). Enquiries came from eleven countries outside the Republic, Spain appearing among these for the first time.

At 40, the number of advisory visits to growers' plantations was less than for many years past, but this was largely accounted for by the inability of the one person remaining in the Entomology Section to meet the requests previously dealt with by two or more staff members. An innovation was a tour of African-owned plantations in Swaziland made by the Assistant Silviculturist, in the company of local Agricultural Officers, at the request of the Swaziland Government. A report on these plantations, with recommendations for their future management, was prepared.

The absence of any groups and the fewer overseas visitors reduced the number of people visiting the Institute to about 60, the lowest figure for many years. These included Mr. J. A. Blott, Vice-Chairman of Messrs. Barrow, Hepburn & Gale, Ltd., and Mr. P. D. Blott, Mr. D. R. Johnston of the British Forestry Commission, and Dr. H. Engel and Mev. Dr. Engel-Ledeboer of Amsterdam. Dr. Engel-Ledeboer will be remembered as an early worker in South Africa on the problem of gummosis in wattle.

Mr. Johnston and Dr. and Mev. Engel were among the 70 or so visitors conducted over the Experiment Station Bloemendal. These included also some 55 growers and friends who attended the Annual Farmers' Field Day held on 28th March. Although weather conditions for this event were favourable, the attendance was unaccountably small, only half those who had signified their intention to be present attending. The demonstrations, nevertheless, proved very interesting and were highly commended by those who were present. Special parties in addition to the above comprised officers of the Department of Water Affairs and students of the Faculty of Agriculture and from Cedara College of Agriculture, who were given practical demonstrations of wattle silvicultural practice.

Among the public and other authorities who consulted the Institute on particular topics were the Government Department of Water Affairs, the Natal Parks Board, the Government of Swaziland, the Colonial Pesticides Research Committee (London), and several banks and insurance companies. As usual, a number of enquiries and interviews referred to commercial and industrial matters.

Fewer commercial samples of wattle bark were analysed for the Government Bark Inspector, but several special samples were examined to assist in an investigation of different bark drying methods.

The depleted Entomology Section was able to carry out the annual survey and analysis of bagworm population and to assist growers in more difficult cases with recommendations about commercial spraying. The treatment of over 4,500 acres was supervised and the results checked as far as man-power allowed. The seasonal forecast of probable bagworm infestation was completed and published in the *Farmer's Weekly* of 21st June, 1961.

Eight scientific and technical papers and two obituary notices written by members of the Institute staff were published during the year; details are given on p. 49 of this Report. Two other contributions await publication.

Institute staff assisted in planning the Wattle Industry exhibit at the Royal Agricultural Society of Natal's 1961 show in Pietermaritzburg.

Staff and students of the University of Natal, particularly in the Departments of Commerce, Economics, and Geography, made use of the Institute Library and other resources, as well as seeking advice from members of staff. Somewhat increased use of the Library has been made by other readers and under the inter-library loans scheme.

Committees, etc.

Committee work and matters arising from it have again taken up much of the time of certain members of the staff. The Director has been very much involved in affairs concerning the African Territories Wattle Industry Publicity Fund Ltd. (ATWIPF) Research Project, while the demands upon Mr. Sherry in connection with technical aspects of the new legislation in the industry have been extremely heavy.

The Director attended a meeting of the Research Advisory Council of the Paint Industries' Research Institute in Durban in April and the Annual Meeting of the Institute in Johannesburg in May. Similar meetings of the Leather Industries Research Institute, as well as its Wattle Technical Committee, were attended in Grahamstown in June, while he, together with Dr. Martin and Mr. Gordon-Gray, attended another meeting of the Technical Committee in Pietermaritzburg in November.

The Director attended all but one of the meetings of the General Committee of the Wattle Growers' Union and served on several of its special sub-committees. He was also called from time to time to attend meetings of the Management and other Committees. He served also on the Union's Pest Control Sub-Committee and on the Department of Agriculture's Co-ordinating Committee for Entomological Research in the Wattle Industry.

In September, 1960, Dr. Shaw accepted an invitation to become Chairman of the South African section of the ATWIPF Wattle Research Advisory Committee set up to collaborate with the remainder of the Committee in London in considering and advising upon proposals for the initiation of research on a broad front into the utilization of wattle products. Early difficulties in the operation of this scheme led to Dr. Shaw's being invited to go to London in February for detailed discussions with the London Committee and the ATWIPF Board. In the event, this involved visits to research centres in England, Scotland, and Germany and the outcome was the successful launching of several research projects designed to widen the field of application of wattle products. One of the immediate results has been to relieve the Wattle Growers' Union of very considerable expenditure in support of wattle utilization research. The implementation of these decisions in so far as they affect matters in South Africa has given rise to many administrative problems that have necessitated a good deal of consultation and correspondence.

The Director and Mr. Sherry again served on the standing Field Experiment Station and Royal Show Committees of the Wattle Growers' Union, while Mr. Sherry served on the Wattle Industry Joint Quota Committee and the Price Formula Committee of the Wattle Growers' Union and on the Executive Committee and the Plantation Valuation Sub-Committee of the South African Timber Growers' Association. He was also concerned in discussions with Department of Agriculture officers and with railway officials in relation to plantation fire prevention and control and was convener of a committee responsible for revising the publication "The Marketing of Wattle Bark".

Conferences, Lectures, Meetings.

On 9th May, 1961, Dr. Shaw delivered his Presidential Address "Research for a Purpose" before the Agricultural Scientific Association of Natal. Mr. Sherry recorded a talk, subsequently broadcast in the S.A.B.C. programme "Calling All Farmers", on the subject of more efficient production methods in wattle growing in relation to current marketing difficulties.

The Institute again collaborated with the South African Timber Growers' Association, this time in a Field Day at Paulpietersburg, where Mr. Sherry spoke on wattle cultural practice. He also took part in a Field Day near Dumisa arranged by the Government Inspector of Wattle Bark. Mr. Atkins gave general talks on wattle silviculture to the Farmers' Association at Commondale and at the Bremersdorp Agricultural Show, the latter talk being illustrated by colour slides.

LIBRARY

The opening up of the new research section of Plant Physiology brought the need for additions to the range of library books and, in all, 37 were added, bringing the total to 420. The addition of 80 bound volumes of periodicals brought the number in this section to 517, while the largest ever annual accession of bulletins, reprints, etc., 420, increased the total of such publications to 3,611.

ACKNOWLEDGEMENTS

The Institute gratefully acknowledges its indebtedness to the undermentioned.

To the Entomologists of the Commonwealth Institute of Entomology and of the British Museum (Natural History) and to Mr. B. Stuckenberg, of the Natal Museum, for assistance in identifying entomological material.

To the Comec Mimosa Extract Co., Ltd., for invaluable assistance by way of providing facilities for sampling and handling parcels of wattle bark from experimental plots.

To the staff of the Biometry Department of the Faculty of Agriculure, University of Natal, for help and guidance in statistical problems arising from Institute experiments.

To all growers who have made available to the Institute portions of their plantations for experiments, and to those who have sent material for the Institute's insect collection.

REVIEW OF WORK IN PROGRESS

(a) SILVICULTURE

1. Thinning Experiments.

(*a*) Experiment S.3 at Bloemendal (Pietermaritzburg district), designed to determine the optimum final density in relation to length of rotation, was re-measured in November, 1960. Comparison of the mean breast height diameters of a fixed number of dominants in each treatment showed that at ten years of age on this site, plots at densities of 550 and more trees per acre were significantly suppressed (P=0·05) in relation to plots at densities of 400 or fewer per acre.

(*b*) Experiment S.5 on the Clan Syndicate estate (Albert Falls district), similar in lay-out to S.3, but on a first quality site, was re-measured in July, 1960. Comparison of mean dominant breast height diameters in this case showed no significant differences in suppression at eight years of age over a range of densities from 400 to 1,000 trees per acre.

(*c*) Experiment S.34 at Bloemendal, similar in objective to the above experiments, was re-measured in December, 1960, at five years of age. Comparisons, based on mean breast height diameter of a fixed number of dominants, showed that plots at a density of 700 trees per acre were significantly suppressed (P=0·01) in relation to plots at a density of 300 per acre.

2. Thinning and Weeding in Relation to Disease Incidence.

Experiment S.44 at Bloemendal was laid out in November, 1958, to compare the effect upon yield and disease incidence of different rates of thinning and different weeding treatments.

The thinning treatments applied were as follows:

Treatment	Number per acre remaining after thinning at mean heights shown					No. of operations
	9 in.	3 ft.	6 ft.	12 ft.	20 ft.	
1	2,400		1,200	700	500	4
2	2,400	800		500		3

These thinning treatments occupied sub-plots in a split-plot design in which main plots received one of the following weeding treatments after a preliminary clean hoeing when the seedlings were nine inches high:

A. Clean weeding by hoeing, with no precautions to avoid root-injury.
B. Clean weeding by hand-pulling.
C. Weed-control by slashing.

D. No weeding. Deliberate root-injury by chopping with a hoe at random on two sides of the stem-base of every tree.

The first three of the above weeding treatments were each carried out twice up to the time the trees had reached a mean height of ten feet, but treatment D was carried out once only, when the trees were about six feet high.

Breast height diameters of all trees were measured in January, 1961, when the stand was three years old, and the experiment was scored for disease in August, 1961. The results were as follows:

Mean d.b.h. in inches

Weeding treatment	Thinning treatment 1	Thinning treatment 2	Mean
A. Weeding by hoeing	3·40	3·43	3·41
B. Weeding by hand-pulling	3·35	3·48	3·41
C. Weeding by slashing	3·33	3·33	3·33
D. No weeding. Deliberate root-injury	2·95	3·30	3·13
Mean	3·26	3·38	

	Weeding	*Thinning*	*Interaction*
Standard error	0·08	0·02	0·04
Significant difference (P=0·05) ..	0·28	0·06	0·12
Significant difference (P=0·1) ..	0·42	0·09	0·17

Percentage healthy trees

Weeding treatment	Thinning treatment 1	Thinning treatment 2	Mean
A. Weeding by hoeing	40·35	23·10	31·73
B. Weeding by hand-pulling	36·53	42·28	39·40
C. Weeding by slashing	67·28	63·45	65·36
D. No weeding. Deliberate root-injury	65·35	59·60	62·48
Mean	52·38	47·11	

	Weeding	*Thinning*	*Interaction*
Standard error	3·71	3·02	6·03
Significant difference (P=0·05) ..	12·84	9·31	18·58
Significant difference (P=0·01) ..	19·45	13·05	26·05

As a result of the loss of information on main-plot comparisons in this type of experimental design, the differences between the mean diameter of unweeded plots and of plots weeded by hoeing or hand-pulling, though actually quite large, were barely significant statistically. On the other hand, the greater precision obtained in sub-plot comparisons indicated a highly significant increase (P=0·01) in mean diameter in plots thinned to final density at a mean height of 12 feet over those thinned finally at 20 feet, although the actual difference in mean diameter was small.

By contrast, there was a marked and highly significant decrease (P=0·01) in the percentage of healthy trees in plots in which weed-growth was completely removed by hoeing or hand-pulling compared with those in which it was slashed or not removed at all, whereas there was no significant difference in disease incidence between the two thinning treatments.

These results suggest that increases in the incidence of gummosis and subsequent infection by wood-rotting fungi are associated with increases in the growth rate of the trees above a certain level. The fact that trees in the unweeded plots showed almost as low a degree of disease incidence as those in slashed plots, despite the fact that they had been subjected to deliberate root injury, suggests further that accelerated growth rate may be a more important factor than mechanical damage to the root system.

Although unweeded plots thinned early to final density showed a highly significant increase ($P=0\cdot01$) in mean diameter over those thinned finally at a mean height of 20 feet, there was no corresponding interaction in respect of disease incidence between this weeding treatment and rate of thinning. A possible explanation is that the increase in diameter of trees in the plots which were thinned early, though much greater than that in plots thinned later, was insufficient to affect disease incidence significantly.

It will be noted that there was a barely-significant interaction in respect of diameter in the case of the hand-weeded plots, but here the response to earlier release was much less marked than in the unweeded plots, where root-competition by weeds served to counteract the effect of the thinning.

It has already been shown (*Report for 1958-1959*) that one hoeing operation early in the life of the stand, followed by one or more slashing operations if vigorous regrowth of weeds rendered this necessary, would give adequate weed control without any significant reduction in the bark yield. At that time, it was observed that the incidence of disease in stands so treated appeared to be lower than that in stands in which weeds had been controlled by means of several hoeing operations. The above results now serve to confirm the correctness of this observation.

3. Complex Tending Experiments.

(*a*) Experiment S.42 at Bloemendal was designed to compare the effects upon growth and yield of three different methods of weed-control and of three different rates and three intensities of thinning.

Treatments were as follows:

Weeding:	(i) No weeding.
	(ii) Weeds controlled by slashing.
	(iii) Weeds controlled by hoeing.
Rates of thinning:	(i) Reduction to final density in four operations.
	(ii) Reduction to final density in three operations.
	(iii) Reduction to final density in two operations.
Intensity of thinning:	(i) Final density of 600 trees per acre.
	(ii) Final density of 500 trees per acre.
	(iii) Final density of 400 trees per acre.

Breast height diameters in this experiment were measured in June, 1961, at three and a half years of age and the results were as follows:

Mean d.b.h. in inches

Weeding method	No weeding 3·29	Slashing 3·25	Hoeing 3·33
Number of thinning operations ..	Four 3·27	Three 3·25	Two 3·33
Thinning intensity	600/acre 3·14	500/acre 3·26	400/acre 3·47

Standard error	0·03
Significant difference ($P=0\cdot05$)	0·09
Significant difference ($P=0\cdot01$)	0·12

Neither the method of weeding nor the rate of thinning had any significant effect upon mean diameter, but diameters were significantly greater (P=0·01) with each reduction of 100 trees per acre in the density of the final stand. There were no significant interactions between treatments.

(*b*) Experiment S.N.8 on the Hermannsburg Mission's Waterval estate at Glückstadt (Vryheid district) was laid out to test the effect upon growth and yield of three different methods of weed-control, three different thinning intensities, and dressings of superphosphate fertilizer at three different levels.

Treatments were as follows:

Weeding:	(i) No weeding. (ii) Weeds controlled by slashing. (iii) Weeds controlled by hoeing.
Intensity of thinning:	(i) Final density of 600 trees per acre. (ii) Final density of 500 trees per acre. (iii) Final density of 400 trees per acre.
Superphosphate:	(i) None. (ii) 200 lb./acre. (iii) 400 lb./acre.

Tree heights in this experiment were measured in June, 1961, at the age of 18 months and the results were as follows:

Mean height in feet

Weeding method	No weeding 9·37	Slashing 9·41	Hoeing 9·75
Thinning intensity	600/acre 9·79	500/acre 9·42	400/acre 9·33
Superphosphate dressing	None 8·53	200 lb./acre 9·98	400 lb./acre 10·04

Standard error	0·161
Significant difference (P=0·05)	0·46
Significant difference (P=0·01)	0·61

Height was not significantly affected either by the method of weed-control or by the intensity of thinning, but plots which received superphosphate fertilizer were significantly taller (P=0·01) than those which did not. There was, however, no significant difference in height between plots which received 200 and 400 pounds of fertilizer respectively.

(*c*) Experiment S.41 at Bloemendal was planned to compare the effects upon growth and yield of three different methods of weed-control, three different intensities of thinning, and dressings of muriate of potash and basic slag, each at three different levels.

Treatments were as follows:

Weeding:	(i) No weeding. (ii) Weeds controlled by slashing. (iii) Weeds controlled by hoeing.
Intensity of thinning:	(i) Final density of 600 trees per acre. (ii) Final density of 500 trees per acre. (iii) Final density of 400 trees per acre.
Muriate of potash:	(i) None. (ii) 200 lb./acre. (iii) 400 lb./acre.

Basic slag:
(i) None.
(ii) 200 lb./acre.
(iii) 400 lb./acre.

Breast height diameters were measured in May, 1961, when the stand was three years and four months old, with the following results:

Mean d.b.h. in inches

Weeding method	No weeding 3·15	Slashing 3·27	Hoeing 3·36
Thinning intensity	600/acre 3·21	500/acre 3·21	400/acre 3·36
Muriate of potash dressing	None 3·26	200 lb./acre 3·25	400 lb./acre 3·27
Basic slag dressing	None 2·98	200 lb./acre 3·37	400 lb./acre 3·43

Standard error .. .. 0·034
Significant difference (P=0·05) .. .. 0·10
Significant difference (P=0·01) .. .. 0·14

Mean diameters in unweeded plots were significantly smaller than in slashed plots (P=0·05) and in hoed plots (P=0·01), but there was no significant difference in mean diameter between slashed and hoed plots. Plots thinned to 400 trees per acre had a significantly larger (P=0·01) mean diameter than plots thinned to 500 or 600 trees per acre, but mean diameter at the two latter densities did not differ significantly. Dressings of muriate of potash up to 400 lb. per acre had no significant effect upon diameter. Plots which received basic slag had significantly larger diameters (P=0·01) than plots which did not, but mean diameters did not differ significantly in plots which received 200 and 400 lb. respectively.

(*d*) Experiment S.45 at Bloemendal was designed to compare the effect of different methods of weed-control, different rates of thinning, different degrees of pruning, and dressings of superphosphate fertilizer at three levels, upon growth rate, yield, and disease incidence.

Treatments were as follows:

Weeding:
(i) Weeds controlled by slashing.
(ii) Weeds controlled by hand-pulling.
(iii) Weeds controlled by hoeing.

Rate of thinning:
(i) Reduction to final density at a mean dominant height of 20 feet.
(ii) Reduction to final density at a mean dominant height of 15 feet.
(iii) Reduction to final density at a mean dominant height of 12 feet.

Degree of pruning:
(i) No pruning.
(ii) Pruning to six-inch stubs to seven feet.
(iii) Pruning flush with the stem to seven feet.

Superphosphate:
(i) None.
(ii) 200 lb./acre.
(iii) 400 lb./acre.

Breast height diameters were measured in February, 1961, when the stand was two years and two months old and the results were as follows:

Mean d.b.h. in inches

Weeding method	Slashing 2·11	Hand-pulling 2·10	Hoeing 2·10
Reduction to final density at height of ..	20 feet 2·13	15 feet 2·07	12 feet 2·11
Pruning degree	No pruning 2·17	7 ft. stub pruning 2·06	7 ft. flush pruning 2·09
Superphosphate dressing	None 1·91	200 lb./acre 2·14	400 lb./acre 2·26

Standard error	0·03
Significant difference (P=0·05)	0·09
Significant difference (P=0·01)	0·12

No differences in mean diameter attributable either to the method of weed control or to the rate of thinning had become evident up to this age. Unpruned plots had a significantly larger (P=0·05) mean diameter than plots pruned to seven feet. Mean diameters were significantly larger (P=0·01) in plots which received superphosphate dressings than in unfertilized plots, and plots which received 400 lb. per acre had significantly larger (P=0·05) diameters than those which received only 200 lb.

4. Use of Wattle in Arable Crop Rotations.

In experiment S.40 at Bloemendal, treatments were repeated for the third time on the same plots (*Reports for 1957–1958, 1958–1959, and 1959–1960*). In view of the failure of the late-planted swede crop in two of the previous seasons, it was decided to omit this planting, and the silage crop (Treatment C) was harvested in March instead of in January as originally prescribed.

The results were as follows:

Treatment	Yield lb. per acre	Equivalent per acre	Estimated net value £ per acre
A. Maize for grain	1,590·0	7·95 bags	8·382
B. Maize for grain	803·0	4·02 bags	4·153
C. Maize for silage	19,871·0	9·94 tons	16·328
D. *Eragrostis* for hay	8,364·0	4·18 tons	22·759

Standard error	1·47
Significant difference (P=0·05)	5·09
Significant difference (P=0·01)	7·71

The yield of maize grain in both the A and B treatments was even lower than in the previous season, when yields were thought to have been reduced by a period of drought during the summer. Since climatic conditions during the past season were not unfavourable, this further fall in yield must be attributed to the reduction in soil fertility caused by continuous cropping. The maize foliage showed clear evidence of nitrogen deficiency and there were signs of potash deficiency, even in the A treatment which received potash. The marked difference in yield between the A and B treatments provided further indication of the rapid depletion of potash in this soil. Once again, however, the difference in net crop value (cash value less cost of fertilizer) between these two treatments was not significant.

The yield of maize silage was also appreciably lower than in the previous season, but the omission of the swede crop allowed a greater profit margin on the silage and its net value was very little below that of the previous season, being significantly higher ($P=0\cdot01$) than that from maize grain in either the A or B treatment.

The general yield reduction was evident also in the *Eragrostis* hay crop, but the value was nevertheless significantly higher ($P=0\cdot05$) than that of the silage crop and, of course, very much higher than that of the grain crops.

As a measure of the effect of potash depletion, it is of interest to note that, while the A, C, and D treatments, all of which received potash, showed yield reductions of between 16 and 20 per cent. over the previous season, the reduction in the B treatment, which received none, was over 35 per cent.

It is apparent from these results that when wattle land is converted to agriculture, fertilizer dressings should include an adequate amount of potash from the outset, and the addition of nitrogenous fertilizer will probably be advisable in the third season and essential in the fourth if yield is to be maintained.

(b) GENETICS AND PLANT BREEDING

1. Interspecific Hybrids.

(*a*) Acacia irrorata x *black wattle* (A. mearnsii). A sample of seed collected by Dr. Philp and Mr. Sherry in 1943 from Sevenoaks, Natal, and called by them "Black Wattle, Sevenoaks", turned out to be mainly *A. irrorata*, but among the seedlings from this sample, a few trees were noticed which appeared to be hybrids with *A. mearnsii*. As the two species, although closely related, differ markedly in several characters, the opportunity was taken to study the inheritance of some of these, more particularly the number of glands on the leaves. In 1958, two of the presumed hybrid trees were selfed and one of them backcrossed to the *irrorata* parent. Seed was sown in January, 1961, and the segregation of some characters has been noted, but the seedlings are still too small to make an accurate count of leaf glands.

(*b*) *Black wattle* (A. mearnsii) x *green wattle* (A. decurrens). Because of the increasing demands made by the selection work in black wattle, the investigation into the genetic behaviour of black x green wattle hybrids was not continued. The small amount of seed obtained last year from selfing the hybrids and backcrossing to the two parents is being held until an opportunity of re-opening this line arises.

2. Inbred Lines of Black Wattle.

(*a*) *Self-pollination of S_1 inbred trees.* Attempts to produce second inbred generation (S_2) lines of black wattle have met with little success so far. In 1959, a total of 8 inflorescences on 5 S_1 trees were self-pollinated, but not a single pod matured. During September and October, 1960, self-pollination of S_1 trees was again carried out and 70 inflorescences were selfed on 18 trees. Checking of the seed has not been completed, so it is not possible to make a final estimate of fertility, but when counts of young pods were made in June, 1961, 40 of the self-pollinated inflorescences had failed to set pods and of the remainder, the majority had only 1–5 pods. As pod-shedding between June and the normal ripening time is common following self-pollination, it seems likely that very few seeds, if any, will result.

(*b*) *Crossing S_1 inbreds.* A number of S_1 inbred families have now been produced and some of these show marked differences in tree form and resistance to gummosis (*Report for 1958–1959*). Crosses have been made between trees selected from the best of these families to try to determine whether this line of breeding holds promise of practical results.

In 1959, 8 crosses were made between 8 S_1 trees of different origin, the seed being harvested in December, 1960. Of these crosses, 1 produced a fairly high number of seeds (71), 3 failed to set seed, while the remainder produced 1–11 seeds only.

During September and October, 1960, a more extensive programme of crossing was carried out using 20 trees between which 28 crosses were made. When pods were recorded in June, 1961, 4 of the crosses had produced none, 13 had numerous pods, and the remainder 1–20 per inflorescence. Allowing for shedding, it seems probable that at least some of the crosses will produce a fair yield of seed.

3. Crossing and Selfing Selected Black Wattle Trees.

Controlled cross-pollination between a number of plus tree selections (confirmed, where possible, by progeny test) was commenced in 1958 with a twofold purpose. All trees used for crossing have been propagated by air-layers to provide clonal material for the establishment of seed orchards, and information from crossing followed by progeny testing should help to eliminate poor clones from such plantations. Secondly, it is considered that if superior progenies from controlled crosses can be found, they will provide material for the establishment of seed orchards by direct seeding and thus obviate the tedious process of vegetative propagation. Work on crossing selected trees was carried out as follows:

(*a*) Nine families from crosses made in 1958 were planted out at Bloemendal during January, 1961. Of these families, 5 are from trees selected for high tannin content and 4 from trees which had a low incidence of gummosis in their open-pollinated progeny.

(*b*) Seed from crosses made in September and October, 1959, (*Report for 1959-1960*) commenced to ripen in late October, 1960, and frequent collections were necessary until January, 1961. Seed was harvested from 35 of the 58 crosses made. Of the remainder, 17 crossed inflorescences were destroyed by storms, 3 failed to set seed, and one tree carrying 3 crosses died. Since a knowledge of the self- and cross-fertility of selected trees is likely to be important when establishing seed orchards, counts were made of the number of mature pods formed per inflorescence following both selfing and crossing; later, records of the numbers of seeds per pod were made following open-pollination, crossing, and selfing. For various reasons, representative samples of open-pollinated seed could not be collected from six trees. As there were no significant differences in the number of pods or in the number of seeds per pod between different crosses on the same tree, the numbers were grouped for each tree. The results are summarized in the following table.

Pods per branch and seeds per pod following open- and self-pollination and controlled crossing, 1959

Tree No.	Pods per branch, crosses		Pods per branch, selfs		Seeds per pod		
	No. of branches	Mean per branch	No. of branches	Mean per branch	Open-pollination	Crosses	Self-pollination
9	9	12·6	9	1·0	7·4	5·2	2·7
18	8	130·9	7	39·8	5·4	4·8	2·6
43	1	28·0	4	8·2	5·8	4·1	2·2
49	–	–	5	1·4	5·8	–	2·0
60	–	–	11	2·4	–	–	1·7
65	4	17·0	9	2·3	–	4·6	2·4
71	–	–	6	20·3	–	–	1·3
75	–	–	7	7·1	–	–	1·9
82	9	214·9	5	113·0	5·0	4·1	2·7
84	5	26·4	13	3·6	5·8	4·2	2·9
85	1	15·0	13	15·5	4·8	4·8	2·0
93	4	27·0	19	32·2	8·0	4·4	2·0
96	9	31·0	8	0·9	6·8	2·9	2·1
101	4	25·0	13	9·5	6·4	7·8	4·0
102	2	189·0	2	21·5	–	4·4	2·5
136	2	4·5	6	0·0	–	4·5	0·0
137	2	57·5	1	0·0	7·9	6·5	0·0
Mean	4·6	59·9	8·1	16·4	6·3	4·8	2·1

The differences between trees for the number of pods per inflorescence and the number of seeds per pod were highly significant ($P = <0{\cdot}01$) following both crossing and selfing. There was a significant correlation between crossing and selfing for the number of pods per inflorescence ($r = 0{\cdot}776$ with 11 d.f.) but there was no correlation for seeds per pod between the two types of pollination or with open-pollination. It would seem, therefore, that counts of the pods per inflorescence and the number of seeds per pod form two quite unrelated estimates of fertility.

(*c*) During September and October, 1960, the programme of crossing selected trees was continued. As before, the trees were divided into two main groups on the basis of tannin content and disease resistance, but other characters, such as tree form and bark thickness, were taken into account as secondary factors. In the high tannin group, 10 trees were selected and 18 crosses made and in the low gummosis group, 14 trees were selected and 30 crosses made.

4. Progeny Testing of Selected Trees.

(*a*) *First trial* (*planted December, 1950, harvested December, 1960*). This first progeny trial, planted at Bloemendal, was a comparison of the open-pollinated progeny of 25 selected trees, arranged in a 5 x 5 balanced lattice with six replications. Unfortunately, when the trees were between six months and one year old, many were blown over and died, while others, left in a leaning position, became so bent as to render later height measurements of little value.

The cause of this set-back was the planting out of seedlings from earthenware pots. The tap roots, which had curled round inside the pots, thickened after transplanting to produce a "spiral spring" effect, which gave the trees insecure anchorage or even pushed them out of the ground. A second factor was the great amount of forking which is apt to take place when trees from pots are planted out at their final spacing. It was decided at the time not to correct forking by pruning, but to allow the trees to develop with a minimum of interference. It appeared later, however, that this was an ill-advised decision, for the multiple stems which resulted created a difficulty when measurements of diameter at breast height (d.b.h.) were made, and no really satisfactory method of correcting these measurements for forking has been devised. These two factors undoubtedly influenced the final results of the experiment and some of the findings must be treated with reserve. Nevertheless, the results showed such clear differences between progenies as to leave little doubt that the main components of yield are greatly influenced by the genetic background and so can be improved by selection.

Harvesting was carried out with the help of the Silviculture Section and the tedious work of sampling and tannin determination was undertaken by the Chemistry Section. The full implications of the trial have not yet been completely worked out, but the main results at harvesting are given below. For ease of comparison, the measurements for each character are given in two ways. The first column gives for each measurement the mean of the six replications of each progeny, and in the second column this figure is shown as a percentage of the mean of all progenies for each character.

The significant difference in stand, which occurs also in other progeny trials, shows that there are inherent differences between progenies in their ability to survive, but because of the effect of transplanting from pots at the final spacing, these differences may have been accentuated. There was a significant positive correlation between stand and diameter ($r = 0{\cdot}603$ with 23 d.f.), which is contrary to what has been found in silvicultural experiments, where a decrease in stand is usually accompanied by an increase in diameter (*Report for 1959–1960*). In the progeny trial, it would seem that the constitutional weakness which causes some families to have a higher mortality than others persists in some degree and results in such families having a smaller diameter than those more fitted to survival.

A comparison of the first diameter measurement, made in 1953 when the trees were $2\frac{1}{2}$ years old, with the last, taken just before felling, showed a fairly high degree of corres-

Results of first progeny trial (1950-1960) as measured and as percentage of the mean

Tree number	Stand		d.b.h. (inches)		Undried bark yield (lb. per tree)		Undried bark yield (long tons per acre)		Percentage tannin (moisture-free basis)		Tannin (long tons per acre)	
	Mean per plot	Per cent.	Mean per tree	Per cent.	Mean per tree	Per cent.	Mean per acre	Per cent.	Mean per plot	Per cent.	Mean per acre	Per cent.
1	10·5	90·5	5·1	92·7	36·5	72·3	5·35	65·3	34·6	92·5	0·91	61·1
2	11·8	101·7	5·7	103·6	53·8	106·5	8·79	107·3	35·7	95·5	1·43	96·0
3	10·0	86·2	4·8	87·3	44·1	87·3	6·10	74·5	37·6	100·5	1·05	70·5
4	13·8	119·0	5·8	105·4	59·2	117·2	11·42	139·4	37·0	98·9	2·09	140·2
5	9·2	79·3	5·4	98·2	43·7	86·5	5·61	68·5	36·7	98·1	1·02	68·4
6	12·8	110·3	5·6	101·8	57·4	113·6	10·20	124·5	37·3	99·7	1·76	118·1
7	10·2	87·9	5·0	90·9	44·6	88·3	6·34	77·4	37·9	101·3	1·16	77·8
8	10·8	93·1	5·4	98·2	50·5	100·0	7·42	90·6	39·8	106·4	1·49	100·0
9	10·3	88·8	5·7	103·7	51·5	102·0	7·41	90·5	37·2	99·5	1·34	89·9
10	12·2	105·2	5·2	94·5	43·4	85·9	7·28	88·9	36·1	96·5	1·30	87·2
11	14·3	123·3	5·6	101·4	53·2	105·3	10·56	128·9	36·2	96·8	1·85	124·2
12	11·8	101·7	5·6	101·8	54·6	108·1	8·77	107·1	39·1	104·6	1·67	112·1
13	10·0	86·2	5·4	98·2	51·4	101·8	7·00	85·5	39·0	104·3	1·36	91·3
14	13·7	118·1	5·5	100·0	56·6	112·1	10·74	131·1	40·0	107·0	2·15	144·3
15	11·8	101·7	5·4	98·2	47·3	93·6	7·84	95·7	37·2	99·5	1·48	99·3
16	8·2	70·7	4·9	89·1	43·4	85·9	5·04	61·5	36·8	98·4	0·92	61·7
17	13·7	118·1	5·4	98·2	45·7	90·5	8·60	105·0	39·5	105·6	1·72	115·4
18	13·7	118·1	5·8	105·4	56·5	111·9	10·68	130·4	36·7	98·1	1·89	126·8
19	9·5	81·9	5·2	94·5	49·7	98·4	6·50	79·4	38·7	103·5	1·20	80·5
20	11·3	97·4	5·8	105·4	60·4	119·6	9·50	116·0	36·0	96·3	1·65	110·7
21	11·7	100·9	5·9	107·3	60·2	119·2	9·72	118·7	38·0	101·6	1·70	114·1
22	12·5	107·3	5·3	96·4	47·6	94·2	8·20	100·1	36·2	96·8	1·44	96·6
23	11·3	97·4	5·6	101·8	46·4	91·9	7·33	89·5	35·4	94·6	1·33	89·2
24	12·5	107·8	5·8	105·4	54·2	107·3	9·43	115·1	37·2	99·5	1·75	117·4
25	12·7	109·5	5·7	103·7	50·4	99·8	8·89	108·5	39·0	104·3	1·68	112·7
Mean	11·6	100·0	5·5	100·0	50·5	100·0	8·19	100·0	37·4	100·0	1·49	100·0
S.E.	0·72	6·19	0·16	2·95	3·13	6·19	0·68	8·25	0·58	1·55	0·13	8·52
Sig. diff. (P=0·05)	2·0	17·3	0·45	8·2	8·8	17·3	1·89	23·1	1·6	4·3	0·36	23·9
Sig. diff. (P=0·01)	2·6	22·9	0·60	10·9	11·6	22·9	2·50	30·5	2·1	5·8	0·47	31·6

pondence ($r=0\cdot761$ with 23 d.f.). The findings confirm the results of the Sweetwaters experiment (Moffett, 1956) and show that some estimate of the relative vigour of a progeny and, indirectly, its bark yield can be made when the trees are as young as $2\frac{1}{2}$ years.

The percentage tannin in the bark was found to be independent of stand, diameter, and bark yield.

Tests were made for correlations of the d.b.h., bark yield, and tannin content of the parent trees with that of their progeny, but no relationship was found for any of these characters. The parent trees were selected from a plantation of somewhat uneven growth and under these circumstances, environmental influences have evidently completely obscured genetic factors. In the fifth progeny trial, parent trees were selected from a plantation of known age and even growth and in this trial, significant parent-progeny correlations have been found. It would seem, however, that phenotypic selection of superior trees is likely to be misleading unless confirmed by progeny tests.

(*b*) *Fifth trial* (*planted 1955*). At present, the tannin content of the bark from wattle trials is not determined until harvesting, but if a fairly reliable estimate could be made at an earlier stage of growth, it would do much to facilitate selection for high tannin. It has been found, for selected trees, that quarter-height samples of bark give a tannin percentage which approximates to the average of the bark of the whole tree (*Report for 1957–1958*). To determine whether this method is practicable over a whole experiment, quarter-height discs of bark were taken from nearly all the trees in the fifth progeny trial (a few were too small to sample), a total of 1,484 trees being sampled during April, 1961.

Since it would have taken too long to measure the height of each tree, several rows were measured and a mean height for the whole experiment estimated. This gave a mean sampling height of $12\frac{1}{2}$ feet from the ground and bark samples were taken at this level irrespective of individual height variation. Samples were removed with a $1\frac{1}{4}$-inch diameter circular punch, four discs being necessary from each tree to provide enough bark for analysis. In order to do as little damage as possible to the trees, the discs were removed close together in a vertical line, the bark being taken from the same aspect of each tree. The results of the tannin analysis are not yet available, but other factors were studied.

Although the sampling was primarily for tannin content, two other observations suggested themselves. As the discs removed were all of equal area, weighing the bark samples should give a rapid method of estimating bark thickness, providing the specific gravity of the bark did not differ greatly from tree to tree. Further, the amount of gumming from the wounds left by removal of the samples might be a good criterion of susceptibility to gummosis.

As the specific gravity of the bark was found to vary between $1\cdot14$ and $1\cdot16$ only, a trial was made on 20 trees to determine what agreement would be obtained when bark thickness was measured directly and when calculated by weighing. Four discs from each tree were measured with calipers (three measurements per disc) and then weighed and their thickness calculated. The correlation between the two sets of measurements was very high ($r=0\cdot994$ with 18 d.f.), but the measured thickness was slightly greater than the calculated thickness, the figures being $4\cdot6$ mm. and $4\cdot3$ mm. respectively. The somewhat higher figure given by measurement is not unexpected, as roughness of the bark tends to exaggerate caliper measurements.

It would seem, therefore, that weighing discs of equal area gives a quick and satisfactory method of measuring bark thickness, but a check on the specific gravity of the bark is probably necessary from time to time.

Over the whole trial, differences between progenies for bark thickness and diameter were significant ($P=<0\cdot01$). Bark thickness and diameter were correlated ($r=0\cdot629$ with 47 d.f.), but analysis by covariance showed that not all the differences between families in bark thickness were due to differences in diameter. When the bark samples were being taken, it was quite evident, without measurement, that some families had thicker bark than others, irrespective of diameter.

Gummosis on the wound left by the removal of the bark discs was recorded three months after sampling. Five categories, numbered 0–4, were used, 0 indicating no gum visible and 1–4 different degrees of severity of gumming. Analysis by overall χ^2 test showed that there was a highly significant difference ($P = < 0 \cdot 001$) between families for the amount of gumming. There is, however, the possibility that gumming following wounding is not connected with naturally occurring pathological gummosis. A comparison of natural gummosis recorded in 1959 and wound gumming in 1961 showed a significant correlation ($r = 0 \cdot 358$ with 47 d.f.). It seems likely, therefore, that gummosis and wound gumming have, in part at least, the same background.

5. Vegetative Propagation.

Vegetative propagation of selected trees was continued. During the season, 135 layers were put on 55 trees, of which 77 per cent. have rooted.

6. Pollination Mechanism.

During November and December, 1960, seed was harvested from an experiment started in September, 1959, to determine to what extent wattle is wind pollinated (*Report for 1958–1959*). The number of pods matured per inflorescence, and the mean number of seeds per pod following unrestricted pollination (uncovered), caging to exclude large insects but not wind-borne pollen, and selfing (bagged), are given in the table below.

Mean number of pods per inflorescence and seeds per pod following open-pollination, caging, and selfing

Tree number	Open-pollinated		Caged		Selfed	
	No. of pods	Seeds per pod	No. of pods	Seeds per pod	No. of pods	Seeds per pod
9	8·8	4·7	5·8	3·2	1·0	2·9
49	23·8	5·8	0·0	0·0	1·3	2·8
60	14·0	6·2	6·8	6·5	2·4	1·7
71	76·0	6·2	11·5	4·5	20·3	1·3
Mean	30·6	5·7	6·0	3·6	6·2	2·2

Grouping the four trees, the number of pods per inflorescence from open-pollination was significantly higher ($P = < 0 \cdot 01$) than from either caged or selfed, but there was no significant difference between the latter two. There was, however, a significant interaction ($P = 0 \cdot 05$) showing that the trees had not all behaved in the same way on caging and selfing. The variation between trees in the number of seeds per pod following caging and the fact that, on the whole, the numbers were higher than following selfing suggest that some degree of cross-pollination had taken place in at least some of the cages. If this was so, it does not necessarily follow that such cross-pollination was due to wind-borne pollen. In practice, it is extremely difficult to keep the inflorescence centered in the cage for a period of some three weeks, and the enclosed flowers may sometimes press against the nylon mesh of the cage. When this occurs, there is the possibility of such flowers being visited by bees. Before repeating the experiment, some alteration in the design of the cage, or in the method of fastening the inflorescence inside, is desirable.

REFERENCE

Moffett, A. A. (1956). The Black and Green Wattle Trials at Sweetwaters. *Rep. Wattle Res. Inst. for 1955–1956*, 30.

(c) PLANT PHYSIOLOGY

The work of this section is in its very early stages and all the work attempted has been under winter conditions. At this stage, all that can be reported is the general trend of the exploratory work so far started.

1. The Biosynthesis of Tannins in Black Wattle.

Whereas the chemical properties of tannins and their components have been under investigation over a long period by many research workers, the physiological approach to the biosynthesis of these compounds in the plant has been neglected.

As the tannin content of wattle bark varies considerably from tree to tree, special care is necessary in the selection of plant material for physiological experiments and it is clearly desirable to work at first on material from single trees. A preliminary attempt was made to keep cut branches alive in culture solutions, but the intake of fluid decreased after only two days. It could be restored for another few days by cutting a short piece from the severed end of the branch, but so far, cut branches are suitable for experiments only for a few days.

2. Vegetative Propagation.

Attempts are in progress to root *Acacia* cuttings on a large scale to provide suitable material for experiments. Branch- and root-cuttings have been treated with indole acetic acid, indole butyric acid, and naphthalene acetic acid, at different concentrations and in different media.

3. The Biosynthesis of Wattle Gum.

Black wattle gum is composed of arabinose, rhamnose, galactose, and glucuronic acid, and analyses of the leaves and the stems are being made, by paper chromatography, in order to locate these substances in the tree. It appears that in healthy one-year-old trees, no free arabinose, rhamnose, or galactose is to be found, either in leaves or in stems. Analyses of older trees and diseased trees are now in progress.

4. The Origins of Gummosis.

The microflora of the soil of heavily diseased plantations is being examined and a considerably increased number of bacteria in seriously affected plantations on sandy soils has been found.

Artificial infection experiments have been started at Bloemendal where two- to three-year-old trees are being treated monthly with soil and soil extracts from areas of heavy infestation.

5. Therapeutic Treatment of Gummosis.

Consideration of the possibility of curing diseased trees led to "injection" experiments. An "injection" technique was developed and a glass apparatus has been designed with which it is possible to measure the quantity of fluid taken in by the tree.

The injection of 8-hydroxyquinoline sulphate was tested at a few centres, but had to be postponed until after the winter. Preliminary experiments on the effect of various metal salts have also been started.

(d) CHEMISTRY

1. Fertilizer Experiments.

(*a*) *Major factorial experiments.*

(i) *Table Mountain Sandstone.* The first cycle of this experiment was harvested in 1959 and identical fertilizer treatments were applied to the re-established plots in

order to measure cumulative effects. Regeneration was slow and patchy owing to weather conditions, and four resowings were necessary. Eventually, a good stand was obtained, only to suffer severe frost and hail damage during 1960. The trees have not yet been measured.

(ii) *Shale.* The experiment was harvested in 1959 and the same fertilizer treatments repeated on the re-established plots. A good stand was obtained on regeneration, but severe damage was caused by larvae of the Wattle Emperor Moth, *Gynanisa maia* (Klug), and by the beetle *Pycnopsis brachyptera* Thoms. The trees, however, made a good recovery.

(iii) *Dolerite.* This experiment will be harvested during the 1962–63 stripping season.

(*b*) *Different forms of phosphate.* The remaining experiment, on dolerite, will be harvested during the 1962–63 stripping season.

(*c*) *Quantity of superphosphate and method of application.* In this experiment, six rates of application of superphosphate are combined with four methods of application. The rates are 0, 50 lb., 100 lb., 200 lb., 400 lb., and 800 lb. per acre.

The methods of application are:

A. Half under the seed before sowing; remainder between the lines one year later.

B. Half in bands on either side of the seedling lines at first thinning; remainder between the lines one year later.

C. All under seed before sowing.

D. All in bands on either side of the seedling lines at first thinning.

The design of the experiment is a 4 x4 latin square for methods of application with plots split for rates.

Estimated undried bark weight (tons per acre) at 7 years

Treatment	Superphosphate lb./acre						
	0	50	100	200	400	800	Mean
A	6·07	6·40	6·54	6·99	7·00	7·34	6·72
B	6·04	6·38	6·31	6·37	7·10	7·08	6·55
C	6·82	6·31	6·65	7·83	8·15	7·76	7·25
D	6·54	6·37	6·05	6·65	7·37	7·14	6·69
Mean	6·37	6·37	6·39	6·96	7·41	7·33	6·81

	Quantity	*Method of application*
Standard error	0·76	2·43
Significant difference (P=0·05)	0·35	1·38
Significant difference (P=0·01)	0·47	2·09

The only significant differences are in rates of application from 100 lb. to 400 lb. per acre; the optimum economic dressing probably lies between 200 lb. and 300 lb., say 2 cwt. per acre.

(*d*) *Gummosis.* There were no significant differences in degree of infection between rates of application of fertilizer.

2. Bark Analysis.

(*a*) *Routine Analysis.* During the year, 621 bark analyses and 2 extract analyses were carried out. Of the bark samples, 38 were analysed for the Government Inspector of Wattle Bark.

(*b*) *Tree and plot sampling.* In harvesting and sampling plots from Institute experiments, a further attempt was made to obtain samples in the field for comparison with the standard ones obtained at the factory after chipping as detailed in the *Report for 1958–1959*, pp. 26–27. Bundles from each plot were weighed, put into a rough press made of wattle poles, and a Veihmeyer soil tube hammered through the pressed bundles to obtain a core of bark pellets. A sufficient number of cores was obtained from random positions to obtain a sample for moisture determination and a further sample for tannin analysis. In this way the total weight of undried bark per plot and estimates of its moisture content and percentage tannin were obtained for comparison with standard duplicate samples for moisture and for tannin taken at the factory on the following day. In this way, 135 plots from a Genetics progeny trial were harvested, sampled, and analysed. There was close agreement between the field samples and the factory ones ($r=0\cdot907$, with 134 d.f.), but the factory samples gave a slightly lower tannin percentage than those taken in the field. An estimate (X) of the percentage tannin in the factory sample can be calculated from the equation $X=0\cdot9104Y-2\cdot64$ where Y is the actual tannin percentage of the field sample. The standard error of this estimate is 0·898, which is only slightly higher than the standard error (0·867) of the actual percentage tannin in the factory samples as calculated from duplicate determinations.

Later, fifteen 1/10 acre plots from the Silviculture run-off experiment were harvested, and as there were fewer plots to harvest in one day, it was possible to take duplicate core samples in the field for analysis as well as the standard duplicate samples at the factory. The results obtained again showed a significantly lower tannin percentage in the factory sample. The correlation coefficient was 0·68, but there were only 15 comparisons as compared with 135 in the previous case. The standard error of the field sample was 1·055 and that of the factory samples 0·867.

On the whole, the results are encouraging, but are subject to the limitations of the sheer physical effort required to drive the soil tube into the bales and more particularly in withdrawing it. In addition, the tube was inclined to push bark aside instead of cutting through, and some pellets were lost from the core during withdrawal. It was decided, therefore, to design and test a mechanical sampling tube driven by a tractor, preferably with a twisting tube which would cut as it was pressed downwards through the bales. It is hoped to have a pilot sampler and press ready for the coming season.

3. Variation in Percentage of Tans and Non-Tans with Age.

Details of this experiment were given in the *Report for 1957–1958*. Briefly, the experiment consists of 196 plots each of six trees laid out in four blocks each of 49 plots. Four plots, in random selection, one from each block, are harvested at six-weekly intervals during the stripping season from October to May. Each tree is measured at harvest for diameter and height, individual tree yields are recorded, and the bark dried and analysed. The results, together with those for previous years, are given below:

	3 years	*4 years*	*5 years*	*6 years*
D.B.H. (inches)	3·0	3·7	4·2	4·2
Height (feet)	31·2	37·7	44·0	44·4
Dry bark weight (lb.)	4·0	7·6	11·0	12·1

The analytical figures covering the whole period are shown in the following table; the tan and non-tan figures are the average of four plots harvested at the same time.

The increase in tannin percentage with age is significant ($P=0\cdot01$) and once again, highly significant differences between harvestings and between years and interaction harvestings x years were obtained. The high tan to non-tan ratios obtained may be the result of the wet conditions experienced right to the end of the stripping season.

Time	Tan per cent.				Non-tan per cent.				Tan/non-tan ratio			
	3 yrs.	4 yrs.	5 yrs.	6 yrs.	3 yrs.	4 yrs.	5 yrs.	6 yrs.	3 yrs.	4 yrs.	5 yrs.	6 yrs.
October ..	35·4	36·2	36·6	36·4	14·3	16·2	16·7	15·9	2·5	2·2	2·2	2·3
November ..	36·0	36·0	38·1	37·7	12·9	14·4	14·9	14·3	2·8	2·5	2·6	2·6
January ..	34·6	37·5	37·4	39·7	13·0	13·1	15·3	12·6	2·7	2·9	2·4	3·2
February ..	35·3	35·4	38·2	39·9	12·5	14·0	14·7	13·3	2·8	2·5	2·6	3·0
March	33·0	35·8	37·5	38·2	14·5	14·7	15·0	13·8	2·3	2·4	2·5	2·8
May	32·6	36·0	37·4	39·1	14·9	14·8	14·3	14·2	2·2	2·4	2·6	2·8
Mean	34·5	36·1	37·5	38·5	13·7	14·5	15·1	14·0	2·6	2·5	2·5	2·8

The rainfall figures in millimetres recorded near the plots are given below:

	3rd Year	*4th Year*	*5th Year*	*6th Year*
August	39·3	10·6	7·6	11·4
September	163·4	67·1	47·2	62·5
October	206·6	43·7	120·9	59·5
November	74·8	179·2	109·4	133·1
December	89·0	189·2	101·8	206·2
January	157·5	185·8	78·0	167·0
February	178·3	139·4	122·1	73·2
March	55·7	63·5	99·6	100·7
April	142·9	58·6	117·0	130·4
	1,108·1	937·1	803·6	944·0

4. Trace Element Experiments.

(*a*) A factorial experiment was laid down at Bloemendal on an ordinary commercial stand to test the effects of boron, copper, iron, magnesium, manganese, molybdenum, and zinc, alone and in all possible combinations, on the growth, yield, and disease resistance of wattle. In an earlier experiment, 200 lb. superphosphate per acre and 130 lb. muriate of potash per acre had given significant yield increases in this area, and this combination was applied with all the trace element combinations in side dressings when the trees were under one year old. Growth was excellent until February–March, 1961, when the plots were infested with the same pests as attacked the major factorial experiment already described. Although severely damaged, the trees have recovered well. Height records and disease scoring will begin after the experiment has been thinned to its final stand.

(*b*) In a more comprehensive factorial experiment (2^8 in eight blocks of eight plots), the same trace element treatments as in (*a*) above are combined with seed relatively resistant and relatively susceptible to gummosis on a very sandy soil derived from Table Mountain Sandstone in an area where both gummosis and black butt are normally severe in trees 5–6 years old and over. A basal dressing of 200 lb. superphosphate was applied with the trace elements before sowing. Seed was sown at stake (three seeds per hill) in paper pots, but germination was poor and in spite of several partial re-sowings, an indifferent stand remains. A final re-sowing will be done as soon as the rains begin.

5. Soil Moisture.

In 1951, an experiment was laid down by the Silviculture section at Bloemendal to study the effects of brushwood burning on the site and on the crop, the former being measured by the loss of water and of litter and soil from plots on different slopes and with different brushwood disposal treatments. A description of the experiment and summaries of results to date have been given by Sherry (*Reports for 1952–1953, 1953–1954, and 1960–1961*).

The scope of the work was later extended, without in any way interfering with the original design, to obtain a clearer picture of the hydrology of land under wattle. To this end, it was considered desirable to devise means of estimating the relative moisture distribution in the soil profile through the complete cycle of the crop, and after thorough examination of various methods, the nylon-stainless steel electrodes of Farbrother and Harrisson (1957) were used.

These electrodes are relatively cheap and easy to make in the laboratory and are durable. They can be set in position without undue soil disturbance and once they are installed, readings can quickly be taken. For our purposes, it was decided to use only the extremes of silvicultural treatment, i.e. no brushpiles and two brushpiles, and to instal four sets of electrodes at the top end and four at the bottom end of each plot, each set consisting of four electrodes spaced at 1′ intervals down to 4′. The resistances of all 320 electrodes in 80 sets can be measured in two or three hours and readings have been made for two years, usually at fortnightly intervals. The results are recorded as the logarithm of the resistance of the electrode in ohms, and no attempt has been made accurately to calibrate the electrode readings as percentage moisture because only an estimate of relative moisture movement throughout the 10-year cycle is needed. The electrode leads, suitably protected in pieces of conduit tubing, have survived one felling, stripping, and brush burning period.

The results so far obtained indicate that during the 7th to 9th year of the crop, the rainfall rarely penetrated below the top 2′ of soil, indicating that the roots of the crop made full use of available moisture. After stripping, however, the soil at 4′ was wetter on the plots with two brushpiles than on those with no brushpiles, although rainfall was comparatively light from the time of stripping to the end of the period under review. For clarity, only the results from 1′ and 4′ electrodes at the bottom end of the plots are given below. In reading the figures, it should be remembered that as soil moisture increases, the electrode resistance decreases. Thus, 5·00 represents roughly 10 per cent. moisture, 4·00 about 16 per cent. moisture, and 3·00 about 22 per cent. moisture.

Resistance of electrodes in log. ohms (means of 20)

Date	Two brushpiles		No brushpiles		Total rainfall
	1 ft.	4 ft.	1 ft.	4 ft.	
1960					
21st November ..	4·34	5·33	4·24	5·32	
5th December ..	4·88	5·35	4·64	5·29	
30th December ..	4·48	4·85	3·58	5·20	526 mm. or about 21 inches
1961					
23rd January ..	4·21	4·75	4·31	5·06	
13th February ..	3·99	4·74	4·02	5·02	
27th February ..	4·96	5·18	4·93	5·11	
Mean	4·48	5·03	4·29	5·17	
TREES STRIPPED					
13th March	3·59	4·65	3·76	5·05	
27th March	4·19	4·78	4·45	5·01	
10th April	2·67	4·49	2·78	4·93	248 mm. or about 10 inches
24th April	2·73	3·99	2·73	4·69	
8th May	2·93	4·02	2·98	4·71	
22nd May	2·85	3·97	2·81	4·72	
5th June	3·09	4·08	3·11	4·74	
Mean	3·15	4·28	3·23	4·84	

REFERENCE

Farbrother, H. G. and Harrisson, L. E., 1957. On an Electrical Resistance Technique for the Study of Soil Moisture Problems in the Field. *Emp. Cotton Gr. Corp. Res. Mem.* No. 27.

(e) ENTOMOLOGY

1. Population Study.

Bagworm infestation degrees in the second ten year cycle were determined in six plantations over an area of approximately 400 acres. One block was photographed.

2. Effect of Bagworm Attack on Increment.

The increment plots were checked and sprayed, one experiment from the air and two from the ground. Both controlled and uncontrolled plots at Ihluku were sprayed from the air and then harvested, but the spraying was not altogether successful and many trees failed to strip. In their first and second year, the trees had a moderate to heavy bagworm infestation and in their eighth year a moderate infestation. Loss of increment due to defoliation amounted to 2,550 lb. per acre.

In the experiments sprayed from the ground, the results were not satisfactory, probably due to the height of the trees.

3. Chemical Control.

(*a*) *Commercial Spraying Campaign, 1960–1961.* The area sprayed under the South African Wattle Growers' Union contract was 4,554 acres, while a further 1,097 acres were treated outside the contract. The insecticide used was again 0·75 lb. toxaphene per gallon of solution in diesel oil and the rate of application in the contract spraying was 2 gals. per acre on 2,236 acres and 3 gals. per acre on 2,318 acres. The aircraft used was a 150 h.p. Piper Pawnee P.A.25 equipped with 42 type D8 nozzles. The working pressure for spraying was 35 lb. per sq. in. for 2 gallons and 45 lb. per sq. in. for 3 gallons at a true air speed of 90 m.p.h. Spraying started on 16th November and ended on 2nd December, 1960.

In a few cases, difficulty was experienced because of unsatisfactory marking of blocks. Results generally were good, but an area of 22 acres at Scheepersnek had to be re-sprayed. For this second treatment, 3 oz. endrin in 3 gallons of diesel oil per acre was used because of the advanced stage of the bagworm, and results were good. In a few cases, the application at 2 gals. per acre gave less than the expected kill, but as only a partial kill is looked for, these plantations were not re-sprayed. These poor results were probably due to physical factors arising from the very high population density.

(*b*) *Experiments with Alternative Insecticides.* Commercial preparations of toxaphene and endrin as water-miscible emulsions and of Sevin and malathion as wettable powders were tested at a range of concentrations on replicated single-tree plots. The results have not been analysed, but the figures indicate that toxaphene at 0·1%, endrin at 0·01%, and Sevin at 0·08% gave comparable high kills, whereas malathion at 0·4% was only moderately effective.

(*c*) *Effect of Insecticidal Spraying on Wattle Insects Other than Bagworm.* Window flight traps were erected at Sevenoaks to intercept insects flying in an aerially sprayed plantation and in an unsprayed control plantation.

4. Biological Control.

(*a*) *1959 Experiment.* Plantations sprayed with virus during November, 1959, were checked in January, 1961. The natural mortality of bagworm collected was 6·8 per cent. and only one was found to have polyhedral wilt.

(*b*) *1960–61 Experiment.* No large-scale trial on the control of bagworm by treatment with virus sprays was possible, but a small-scale, replicated, single-tree plot experiment was attempted to compare virus preparations with *Bacillus thuringiensis*. The result was inconclusive because of a very high mortality (>75%) in the untreated controls.

5. Identification of Wattle Insects.

No new insect pests of wattle were found during the year.

6. Records of Insect Outbreaks.

Apart from bagworm, no insect attacks of note were reported during the year.

7. Wattle Insect Collection.

Eleven species not previously observed on wattle were added during the year, bringing the total to over 270.

PROGRESS REPORTS AND PAPERS

THE EFFECT OF DIFFERENT METHODS OF BRUSHWOOD DISPOSAL UPON SITE CONDITIONS IN WATTLE PLANTATIONS. III. RUN-OFF BEHAVIOUR OVER A NINE-YEAR ROTATION

By S. P. SHERRY

Measurements made throughout the life of a typical wattle plantation showed that annual run-off decreased rapidly after the first rainy season following the establishment of the crop and reached a minimum in the fourth rainy season. Thereafter, it increased steadily and in the ninth season, when the crop was harvested, reached a level equivalent to about half that recorded in the first season.

Although differences in mean breast height diameter between treatments at the time of harvesting suggested that brushwood disposal methods may have influenced site quality, this result was not borne out by the final bark yields, which showed no significant difference attributable to brushwood treatment.

In this experiment (Sherry, 1953), comparable plots were selected on moderate and steep slopes in a wattle plantation at Bloemendal, the Wattle Research Institute Field Experiment Station, and the following brushwood disposal methods were applied after felling the standing trees.

(*a*) Brushwood was stacked in five parallel piles, 12 feet wide and 12 feet apart, across the width of the plot and at right angles to the direction of slope, and completely burnt as soon as possible after rain.

(*b*) Brushwood was stacked in two parallel piles, 12 feet wide and 28 yards apart, across the plot as in (*a*), and the upper pile was burnt as soon as possible after rain.

(*c*) Brushwood was stacked as in (*b*), but not burnt.

Burning of the brushwood was carried out in April, 1952, and covered, brick tanks designed to collect run-off water and transported soil and litter were built below each enclosed plot during the ensuing dry winter period, thus enabling run-off measurements to be begun at the outset of the 1952–1953 rainy season.

No soil- or litter-loss was recorded after the second year of the experiment, but run-off measurements, summarized in Table I, were continued throughout the nine-year life of the wattle crop.

During a heavy storm in the first rainy season, flood water from roads entered three of the plots (Sherry, 1954), and the records for this season are consequently not complete. In Table I, therefore, since no figures were available for the flooded plots, those for the unaffected member of each plot pair are compared with the means of plots for which data are complete.

A greater volume of run-off was measured in all treatments during the first season after establishment than in any other year during the life of the crop, and the run-off from steep slopes was more than double that from moderate slopes in all plots except those in which no burning took place. The run-off from plots in which all brushwood was burnt was approximately double that from plots in which only one brushpile was

TABLE I

Mean run-off in gallons per acre in relation to rainfall

Season	Total rainfall		No. rainy days	Rainfall causing run-off		Times run-off occurred	Moderate slope			Steep slope		
	mm.	in.		mm.	in.		Brush-piles unburnt	Alternate brush-piles burnt	All brush-piles burnt	Brush-piles unburnt	Alternate brush-piles burnt	All brush-piles burnt
1952—1953	858·10	33·78	106	436·50	17·19	19	7,025*	10,300	25,825	11,875*	30,000*	58,713
1953—1954	955·65	37·62	121	555·60	21·87	21	4,188	5,763	5,450	4,825	7,900	38,063
1954—1955	941·80	37·08	130	480·00	18·90	13	3,555	863	3,538	1,200	1,975	2,188
1955—1956	884·62	34·83	128	127·60	5·00	3	1,125	175	1,125	450	625	738
1956—1957	1,000·20	39·38	132	187·50	7·38	5	425	1,413	1,475	2,225	1,888	3,500
1957—1958	1,365·65	44·71	138	192·20	7·57	5	1,253	1,628	1,800	1,738	1,650	2,945
1958—1959	1,159·00	45·63	120	683·70	26·92	13	4,340	5,783	10,440	5,325	6,000	12,563
1959—1960	819·00	32·24	129	226·30	8·91	5	2,825	3,925	11,120	3,834	3,787	13,100
1960—1961	1,072·50	42·22	122	325·30	12·81	7	4,593	6,255	14,370	6,763	6,843	22,550
Total run-off per acre						.. ..	29,329	36,105	75,143	38,235	60,668	154,360
Equivalent rainfall						.. ..	32·84 mm. (1·29 in.)	40·42 mm. (1·59 in.)	84·13 mm. (3·31 in.)	42·81 mm. (1·68 in.)	67·92 mm. (2·67 in.)	172·82 mm. (6·80 in.)

*Data from one plot only.

burnt and four times that from the unburnt plots. Owing to the loss of information from the flooded plots, no statistical analysis of run-off over the whole season was possible, but the results from a single heavy storm early in the season showed a highly significantly greater volume of run-off from plots in which all brushwood was burnt than in those in which there was no burning or only partial burning. It is probable, therefore, that similar differences existed over the season as a whole.

In the second season, there was a marked reduction in the volume of run-off in all treatments, and in most plots this was less than half that recorded in the first season. There were no significant differences attributable either to slope or to treatment. As the rainfall during this season was actually higher and run-off slightly more frequent than in the previous one, the reduction in volume could be attributed mainly to the development of a dense ground cover of grass and weeds after hoeing was discontinued at the end of the first summer after planting. The part played by crown interception of rainfall in reducing run-off must have been very slight, as the trees had attained a mean height of only about 15 feet and the canopy had not yet closed by the end of the second rainy season.

The correlation between total run-off and percentage ground cover during the second rainy season is illustrated in Text-fig. 1 in which points representing the members of plot pairs which received the same treatment are joined by straight lines. It will be noted that, with one exception, these lines follow a similar trend and that the pairs representing comparable brushwood treatments have approximately the same gradient, which increases with the degree of brushwood removal.

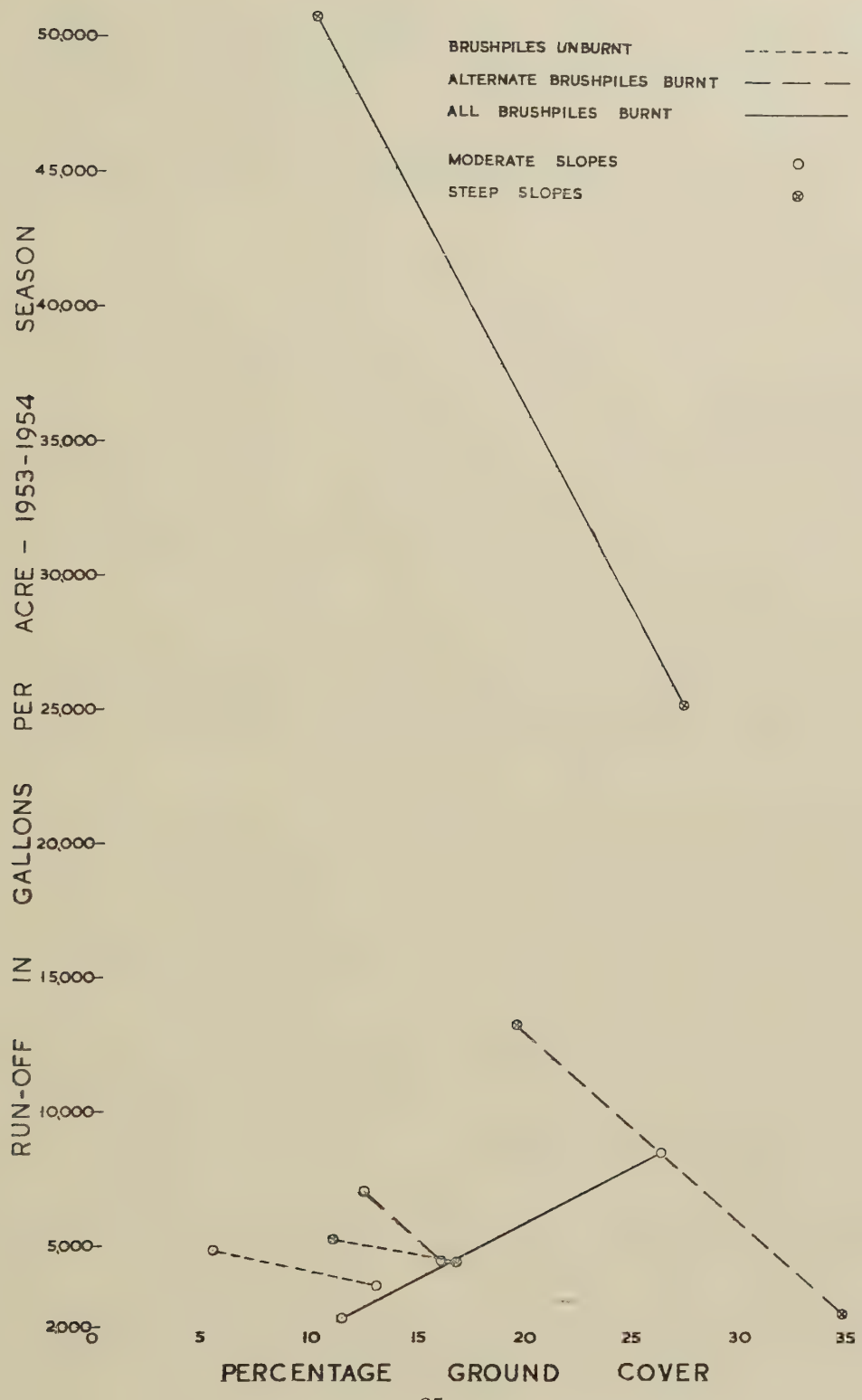
The exception is provided by the two plots on the moderate slope in which all the brushwood was burnt. Here, the trend of the graph is in the opposite direction to those of all the others, and indicates that run-off has been greater on the plot with the higher percentage ground cover. This anomalous result may be due to the fact that the soil surface of the plot with less weed cover had a dense carpet of moss, which probably absorbed much of the rain that would otherwise have run off, whereas the other member of this plot pair, though fairly grassy, had no moss cover, and consequently lost more water as run-off.

In the third rainy season, the volume of run-off was appreciably less than in the second, particularly on steep slopes, where it was actually lower than on moderate slopes. This was due to the greater density of ground cover on the steep slopes, where extensive erosion of litter had exposed the mineral soil and provided suitable conditions for the germination of weed and grass seed. No significant differences were observed.

With the exception of plots on moderate slopes in which no brushwood was burnt, run-off was at its lowest in the fourth rainy season. This was due partly to increased interception by the developing crowns and partly to the fact that there were fewer individual precipitations of high intensity, while total rainfall was lower than during the two previous years. The failure of the above-mentioned pair of plots to conform with the remainder was caused by an abnormally high run-off recorded from one of them on one occasion, for which no obvious explanation could be found. Again, however, there were no significant differences.

The fifth rainy season was the wettest up to that stage of the experiment, and run-off increased in all but the plot referred to in the preceding paragraph, which showed a marked decrease over the previous season. Although the differences were not significant, there was a tendency for run-off again to be greater on the steep than on the moderate slopes, since by this time ground cover was beginning to die off over the whole experimental area as a result of increased shading and root competition, but was doing so more rapidly on the steeper slopes because of the lower moisture content of their surface soils. An additional reason for the general increase in run-off rate this season was the rather irregular distribution of rainfall, which permitted repeated drying out of the surface layers and tended to inhibit infiltration.

The sixth season was slightly wetter than the fifth, but rainfall was more evenly distributed, giving improved conditions for infiltration and consequently less run-off


BRUSHPILES UNBURNT
ALTERNATE BRUSHPILES BURNT
ALL BRUSHPILES BURNT
MODERATE SLOPES
STEEP SLOPES
RUN-OFF IN GALLONS PER ACRE - 1953-1954 SEASON
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
2,000
0
5
10
15
20
25
30
35
PERCENTAGE GROUND COVER

from the steeper slopes than was the case in the latter season. Run-off on the moderate slopes, however, was greater than in the fifth season, and this is thought to have been due to the fact that die-back of ground cover was only now taking place on these slopes and was consequently offering less obstruction to run-off, as well as making smaller demands upon the ground water.

For the first time since the initial season, run-off in plots in which all brushwood had been burnt was significantly higher than that in the other two treatments, but slope differences were not significant, as Table II shows.

TABLE II

Mean run-off in gallons per acre in the sixth (1957–1958) rainy season

Slope	Brushpiles unburnt	Alternate brushpiles burnt	All brushpiles burnt	Mean
Moderate	1,253	1,628	1,800	1,560
Steep	1,738	1,650	2,945	2,111
Mean	1,495	1,639	2,373	

	Slopes	*Method of brushwood disposal*
Standard error	498·7	130·1
Significant difference (P=0·05)	8,799	511
Significant difference (P=0·01)	44,085	847

In the seventh season, with the almost complete disappearance of the ground cover and a total rainfall which was not only higher than normal, but was also irregularly distributed, the amount of run-off increased sharply, particularly in the burnt plots, and was almost as great on moderate as on steep slopes.

TABLE III

Mean run-off in gallons per acre in the seventh (1958–1959) rainy season

Slope	Brushpiles unburnt	Alternate brushpiles burnt	All brushpiles burnt	Mean
Moderate	4,340	5,783	10,440	6,854
Steep	5,325	6,000	12,563	7,966
Mean	4,833	5,892	11,502	

	Slopes	*Method of brushwood disposal*
Standard error	2,332·2	1,045·9
Significant difference (P=0·05)	41,904	4,107
Significant difference (P=0·01)	209,938	5,807

As in the sixth year, differences in run-off attributable to slope were not significant, but run-off was significantly higher in plots in which all brushwood had been burnt than in those in which no burning or partial burning had taken place.

Rainfall in the eighth rainy season was the lowest during the entire period of the experiment, but was well-distributed. Although run-off showed a decrease over the previous season in all plots in which no burning or only partial burning had taken place, it actually increased in the plots in which all brushwood had been burnt.

TABLE IV

Mean run-off in gallons per acre in the eighth (1959–1960) rainy season

Slope	Brushpiles unburnt	Alternate brush-piles burnt	All brushpiles burnt	Mean
Moderate	2,825	3,925	11,120	5,957
Steep	3,834	3,787	13,100	6,907
Mean	3,330	3,856	12,110	

	Slopes	*Method of brush-wood disposal*
Standard error	3,330·2	1,005·1
Significant difference (P=0·05)	59,840	3,946
Significant difference (P=0·01)	299,801	6,544

The difference in run-off between the plots with all the brushwood burnt and those of the other treatments was highly significant, but there were no significant differences attributable to slope.

In the ninth rainy season, rainfall was considerably higher than in the previous year, and this increase was reflected in a sharp rise in run-off in all plots, bringing the total water-loss for this season in most of the treatments to at least half that recorded in the first rainy season.

TABLE V

Mean run-off in gallons per acre in the ninth (1960–1961) rainy season

Slope	Brushpiles unburnt	Alternate brush-piles burnt	All brushpiles burnt	Mean
Moderate	4,593	6,255	14,370	8,406
Steep	6,763	6,843	22,550	12,051
Mean	5,678	6,549	18,460	

	Slopes	*Method of brush-wood disposal*
Standard error	3,302·6	1,028·2
Significant difference (P=0·05)	59,344	4,037
Significant difference (P=0·01)	297,316	6,695

The differences in run-off between plots in which all brushpiles had been burnt and those in which no burning or partial burning had taken place were again highly significant, but differences attributable to slope were not significant.

Over the nine-year wattle rotation, the water-loss due to run-off in plots in which all the brushwood had been burnt was more than twice as great on moderate and four times as great on steep slopes as that in plots in which no burning took place. Plots in which alternate brushpiles were left unburnt lost rather more water than unburnt plots, but much less than plots in which all the brushwood had been destroyed. The mean total water-loss from the latter on steep slopes amounted to the equivalent of 173 mm. (6·80 in.) of rainfall over the nine-year period and on moderate slopes to about half that quantity.

Effect of Erosion on Site Quality.

After the original wattle stand had been felled and the boundaries of the sub-plots demarcated at the outset of the experiment, the diameters of the stumps within each

sub-plot were measured in order to provide a further check on the uniformity of the site before any of the brushwood treatments had been applied.

Figures are presented in Table IV showing these mean stump diameters in relation to the mean tree heights of the new crop at 12 months and 18 months of age respectively, to mean breast height diameters of the new crop just before harvesting at nine years of age, and to the wet bark yields from the harvested plots.

The number of trees per acre in the old crop is given in this table along with their corresponding mean stump diameters, and these figures show that stand density was generally higher on moderate than on steep slopes. Since there was no significant difference in mean stump diameter over the area as a whole, it may be inferred that site quality was slightly better on the moderate slopes. The absence of any significant differences in mean heights of the new crop at 12 months of age, however, suggests that site differences, if they existed, must have been slight. These height measurements were taken only two or three weeks after the major soil-loss of the first rainy season had taken place, and it is unlikely that erosion could have influenced site quality sufficiently at this stage for the effect to have been expressed in mean tree height. Nine months later, however, just after the beginning of the second rainy season, there was a small, but significant, difference between mean heights on moderate and steep slopes, although no differences attributable to the method of brushwood disposal were evident. It would appear, therefore, that at this stage, the effects of the very considerable soil-loss on steep slopes during the first rainy season were beginning to appear.

At the time of harvesting, there were significant differences in mean diameter between slopes and, in addition, the mean diameters of plots in which all the brushwood had been burnt were significantly smaller than those in either of the other two treatments. In the case of the final bark yields, however, no significant differences attributable to brushwood treatment were found, but yields were significantly lower on steep than on moderate slopes.

The fact that the mean diameters in plots in which all the brushwood had been burnt were significantly smaller at nine years of age than those in the other two treatments, suggests that this method of brushwood disposal has caused a significant deterioration in site quality over one nine-year wattle rotation. But the absence of any significant corresponding reduction in bark yield from plots which received this treatment, and the fact that the reduction in diameter, though significant, was not great, renders such a conclusion hardly justifiable. Evidence of the development of differences in growth rate between treatments is, nevertheless, sufficiently strong to justify the prediction that yield differences are likely to have reached a significant level by the end of the next rotation.

It is probable that the very considerable soil-loss suffered by plots which were flooded during the first rainy season was at least partly responsible for the reduction, both in mean diameter and in bark yield, in plots in which no brushwood was burnt, by comparison with those in which alternate brushpiles were burnt. Two plots of the former treatment, one on a moderate and one on a steep slope, were flooded, while one plot only of the latter treatment, on a steep slope, suffered similar damage. The unburnt plot on the moderate slope was quite badly scoured by flood-water, as was the plot with partial burning on the steep slope, but the unburnt plot on the steep slope suffered by far the greatest degree of erosion. It is not surprising, therefore, that the yield of the unburnt plots on moderate slopes is lower than that of the partially burnt plots, but it is noteworthy that the former treatment slightly outyielded the latter on the steep slopes, despite the serious damage suffered by one of its plots.

Proposals for the Continuation of the Investigation.

The harvesting of the wattle crop on the experimental area marked the end of the first cycle of the experiment. A new wattle stand was established shortly after felling the mature crop, and the treatments involving non-burning and complete burning of brushwood were repeated on the same plots as before. The treatment involving the burn-

TABLE VI

Mean growth and yield data as a guide to site uniformity

Slope	Brushpiles unburnt	Alternate brush-piles burnt	All brushpiles burnt	Mean		Slopes	Method of brush-wood disposal
			(a) Mean stump diameter of old crop (inches)				
Moderate	4·50(580;470)*	4·60(700;560)*	4·65(670;610)*	4·58(600)*	Standard error	0·012	0·144
Steep	4·55(500;430)*	4·45(590;480)*	4·70(560;470)*	4·57(505)*	Significant difference (P=0·05)	0·22	0·57
Mean	4·53(495)*	4·53(580)*	4·68(580)*		Significant difference (P=0·01)	1·08	0·94
*Number of trees per acre in the old crop.							
			(b) Mean tree height of new crop 12 months after establishment (feet)				
Moderate	7·48	7·17	7·40	7·35	Standard error	0·173	0·285
Steep	7·54	6·86	6·73	7·04	Significant difference (P=0·05)	3·11	1·12
Mean	7·51	7·01	7·07		Significant difference (P=0·01)	15·57	1·86
			(c) Mean tree height of new crop 21 months after establishment (feet)				
Moderate	10·65	9·88	10·06	10·19	Standard error	0·037	0·380
Steep	10·35	9·07	8·91	9·44	Significant difference (P=0·05)	0·66	1·49
Mean	10·50	9·47	9·48		Significant difference (P=0·01)	3·29	2·47
			(d) Mean breast height diameter of new crop at harvesting (inches)				
Moderate	6·05	6·20	5·95	6·07	Standard error	0·183	0·387
Steep	5·60	5·55	5·35	5·50	Significant difference (P=0·05)	0·33	0·15
Mean	5·83	5·88	5·65		Significant difference (P=0·01)	1·63	0·25
			(e) Mean wet bark yield of new crop at 9 years of age (long tons)				
Moderate	9·24	10·08	8·96	9·42	Standard error	0·045	0·320
Steep	7·56	7·45	6·91	7·31	Significant difference (P=0·05)	0·80	1·26
Mean	8·40	8·76	7·93		Significant difference (P=0·01)	4·01	2·08

ing of alternate brushpiles will not be repeated during the forthcoming cycle, but the effect of removing all brushwood without the use of fire will be tested on the plots previously under this treatment.

It is proposed to harvest the next wattle crop at ten years of age instead of nine, and measurement of run-off, soil-loss, and litter-loss will be continued until the time of harvesting.

A recording rain-gauge has been installed on open land within 150 yards of the experimental area, and this will make possible the determination of rainfall intensities in relation to run-off as well as providing a more accurate record of precipitation on the plots than was possible with the gauge used previously, which was some 700 yards away. It is hoped also to maintain a continuous record of soil-moisture fluctuations to a depth of four feet as well as measurements of throughfall and stem-flow. These measurements, together with the record of water-level fluctuation in a borehole sunk in the centre of the experimental area, should provide a fairly complete picture of the hydrologic cycle in a wattle plantation.

REFERENCES

Sherry, S. P. (1953). The effect of different methods of brushwood disposal upon site conditions in wattle plantations. I. Experimental layout and apparatus designed for the measurement of run-off and soil-loss. *Rep. Wattle Res. Inst. for 1952–1953*, (1953), 33–41.

Sherry, S. P. (1954). The effect of different methods of brushwood disposal upon site conditions in wattle plantations. II. A study of run-off and erosion during the first two years after clear-felling and regeneration. *Rep. Wattle Res. Inst. for 1953–1954*, (1954), 27–36.

NOTES ON WATTLE INSECTS OBSERVED DURING THE PERIOD 1960-1961

By H. SHAW and G. B. WORTMANN

An account is given of wattle insects observed during 1960–1961 and of the areas affected and the damage done. Wattle bagworm was the only insect to cause damage of economic significance.

With the exception of infestation by wattle bagworm, the incidence of insect pests of wattle was lower in the season 1960–61 than for many years past and in the case of many pests normally encountered, no reports of outbreaks were received from any area.

I. ORDER: LEPIDOPTERA

Family: *Psychidae*

1. *Wattle Bagworm,* Kotochalia junodi (*Heyl.*).

During the summer of 1960–61, the most severe and widespread bagworm infestation for many years was experienced and the total area affected almost certainly exceeded the previous year's figure of 250,000 acres.

In the southern area, the prodromal stage has been entered in plantations at Lusikisiki, Flagstaff, and Bizana, and several hundred acres are likely to be defoliated in 1961–62. Plantations between Harding and Weza are heavily infested and defoliation will occur. On the Paddock side of Harding, the peak has been passed, but around Paddock itself, an infestation is building up and several hundred acres will be moderately affected. Abatement in the infestation took place in the Ixopo and Eston areas, but defoliation was heavy in the Richmond district and is likely to be repeated there in 1961–62. The crisis, however, is expected to occur late in the season.

About 1,000 acres were infested in the Lion's River-Howick-Karkloof area. At Dargle and in parts of Tweedie, the infestation is on the upgrade, but an abatement is taking place in many plantations in the Karkloof.

In the Midlands, over 56,000 acres are infested, about three-quarters of this being in the light to moderate grade. Heavy infestations were experienced around New Hanover, parts of Dalton, and near Ahrens, while smaller areas at Kranskop, Greytown, Wartburg, and Table Mountain suffered severe attack. The infestation in these districts is on the upgrade and a larger acreage is expected to be defoliated during 1961–62. Some 28,000 acres in Zululand are infested, but the abatement has set in around Melmoth. On the Kranskop side of the area, however, the infestation is still on the upgrade.

In northern Natal, several thousand acres at Scheepersnek and towards Kambula were defoliated, and although the crisis is expected in some parts of the Scheepersnek area, an even greater area, especially around Kambula, may be defoliated in 1961–62. At Glückstadt, the infestation is generally on the downgrade, but remains heavy in a few plantations; several hundred acres in the Enyati district will again be defoliated. Information is lacking from the Paulpietersburg area, but it is believed that almost the whole was infested, with possibly one half in the heavily infested class. Several thousand acres, particularly on the Vryheid side, will again be defoliated, but the crisis is expected to set in during 1961–62.

The infestation in the Transvaal is heavy, and severe defoliation was widespread between Paulpietersburg and Piet Retief, around Piet Retief, and towards Iswepe. The crisis may set in during the coming summer, but there will still be extensive defoliation and the infestation may even increase around Iswepe and towards Panbult.

Family: *Saturniidae*

2. *Wattle Emperor Moth,* Gynanisa maia (*Klug*).

There was a severe local attack at Bloemendal (Pietermaritzburg district) and serious defoliation occurred.

Two new parasites of this moth were found and identified as *Sarcophaga exuberans* Pandelle (*Sarcophagidae*) and *Discomyza similis* Lamb (*Ephydridae*). The former is a true parasite; the latter may have attacked only a moribund larva.

Family: *Cerambycidae*

3. *Short-winged Longhorn Beetle,* Pycnopsis brachyptera *Thoms.*

A severe, but localized, attack occurred at Bloemendal and the beetle was also reported from Wartburg.

Family: *Tenebrionidae*

4. Perichilus ditissimus *Pér.*

The beetle was found in plantations at Howick, but the defoliation that occurred was probably caused by other insects.

ACKNOWLEDGEMENTS

Acknowledgement is made to the growers who have furnished information and records of wattle insect pests and to Mr. B. R. Stuckenberg, of the Natal Museum, for identification of the parasites of *Gynanisa maia.*

GROWERS' BULLETINS

THE CONVERSION OF WATTLE LAND TO OTHER FORMS OF LAND USE

By S. P. SHERRY

Introduction.

As a result of a fall in demand for vegetable tans on overseas markets, it has been found necessary to impose restrictions on the stripping of wattle bark for supply to mills and extract factories in the Republic. In consequence, growers whose plantations are planned in a regular series of age gradations are unable to strip all the bark which reaches maturity each year and are faced with a cumulative build-up of stands in the older age-classes.

In order to meet this situation, many growers are considering converting felled wattle stands to other crops rather than re-establish them to wattle. These notes have been prepared, therefore, to indicate to growers the various possibilities which exist for the conversion of wattle land to other forms of use, to make available the experience gained at the Wattle Research Institute Field Experiment Station in conversions to field crops and pasture, and to outline the main points to be borne in mind when converting from wattle to other crops. It cannot be too strongly emphasized that the high nitrogen content and general fertility level of old wattle land provides a most favourable basis for the growing of any subsequent crop and must be regarded as an extremely valuable asset.

Preliminaries to a Conversion Scheme.

If it is the intention to maintain any portion of an existing estate under wattle, the need for ensuring that this portion comes into cycle as soon as the last of the original plantations is stripped will influence the rate of conversion to some extent. Since, however, the average grower will not wish to forfeit any part of his potential income from bark, the rate of conversion is bound to be largely influenced by the percentage quota which is imposed.

For example, if a 50 per cent. quota were to be imposed indefinitely, a grower with his acreage divided into ten age classes of equal area would fell the last trees in his cycle at the age of 20 years. He could, therefore, if he wished, convert every acre felled for the first ten years and then re-establish all areas felled in the following ten years to wattle. This would reduce his wattle acreage by half and leave him with 10-year-old trees to strip in the year following the completion of the first 20 year cycle. Under an 80 per cent. quota, on the other hand, the same grower would fell the last trees in his first cycle at only 13 years of age. If, therefore, he wished to reduce his acreage and also ensure having 10 year old trees to strip at the beginning of his second cycle, he would be able to convert the whole of his felled acreage for only the lirst 3 years and would have to re-establish to wattle all areas felled thereafter.

In practice, it will seldom be possible to work out a conversion scheme in the regular manner indicated in the above examples, since the grower will obviously wish to convert those plantations which have proved least successful under wattle, and these may come up for felling at a number of different stages during the cycle. It will be necessary, therefore, first of all to select the plantations which are to be converted and then to

plan the conversion scheme so as to comply with current quota restrictions and, at the same time, ensure the maintenance of a continuous felling cycle without serious annual fluctuations.

Such a system should cover the full period necessary to replace wattle with other crops on the sites selected for conversion, and to bring the remaining wattle plantations into a regular felling cycle. Changing circumstances in the wattle industry, however, will probably necessitate amendments from time to time, so the basic scheme should be regarded as a general guide, and detailed planning should be on a year to year basis.

Three main considerations will govern the choice of crops to replace wattle on a particular site, firstly that the crop chosen will grow satisfactorily on the site in question, secondly that its cultivation will not involve any departure from sound soil conservation practice, and lastly that the produce from it is likely to command a ready sale at a reasonable profit. Once these requirements have been satisfied, the next step is to consider the actual conversion operation.

The Conversion Operation.

Crops which may be used in conversion operations on old wattle land fall into two main categories, namely those which require complete soil preparation for their successful establishment and those which can be established in prepared furrows or spots without the need for removing all the wattle stumps. All arable crops, most types of pasture, orchard crops, and perennial row crops fall into the former category, while timber tree crops and pastures which are mainly grazed fall into the latter.

On land which is level or so gently sloping as to be easily protected by contour drains when brought under the plough, there will be no need to retain any of the brushwood, and this should be burnt as soon as possible after the wattles have been felled and the timber removed. The land may then be stumped, either by hand labour or by mechanical means if a bulldozer is available. Hand-stumping should be done as piecework and 25 stumps averaging 5 to 6 inches in diameter per man-day may be regarded as a reasonable task. If a bulldozer is to be used for stumping, it will be advisable to leave stumps at least 2 feet in height so that the blade can be raised to obtain maximum leverage in removing them. If it is possible to delay stumping for a year after felling, the partial rotting of the tree roots will make it possible to carry out the operation much more easily and at about half the cost of stumping immediately after felling.

If wattle brushwood is neatly stacked on the contour, in rows about 30 yards apart, and left unburnt, these brushpiles will give sufficient protection against erosion to make possible the establishment of permanent pastures on land with a slope as steep as 1 in 8. In such cases, the contour lines are laid off before felling the plantation, and their positions are marked by pairs of pegs driven in at intervals of about 50 feet. At felling, the brushwood is stacked between the lines of pegs and only the stumps between the brushpiles need be removed before ploughing.

If stumping is carried out soon after felling, every effort should be made to complete it early enough in autumn to permit the land to be ploughed before winter and left fallow until the following spring. This allows the leaf litter, incorporated with the soil by ploughing, to decompose to some extent before the new crop is planted. The land should be reploughed and disc-harrowed in the spring before planting either arable crops or pastures.

Some stumping will normally be necessary in converting wattle to orchard crops such as pecan nuts, avocados, or citrus, or to perennial row crops such as New Zealand flax, since all these crops require inter-row cultivation at intervals for the control of grass and weeds. When carrying out such conversions, it will probably be best to peg out the planting positions for the new crop before stumping is begun, and then to remove only those stumps which will interfere with planting or subsequent inter-row cultivation. A similar procedure will be advisable when converting to gum plantations, since most eucalypt species suffer a serious growth check during the first twelve to eighteen months after planting if they are not kept free from weed-competition by disc-harrowing.

In converting wattle to pine, stumping is not essential, but control of weeds by slashing will be facilitated if the wattle stumps can be cut off close to the ground level with a mechanical saw before the pines are planted.

On sites where the rainfall exceeds 40 inches, such cutting of stumps will obviate the need for stumping when establishing grass pastures which are to be mainly grazed. With stumps cut low, the soil can be broken up with a heavy disc in the late autumn, fallowed over winter, and disc-harrowed two or three times in the spring before planting the kikuyu grass. It may be necessary to hand-pull wattle growth once or twice before the grass has become established, after which any wattle regrowth will be controlled by grazing.

When planting out seedlings of any kind in old wattle land, it is essential to prepare the planting holes deeply enough to ensure that the roots of the transplant are in the mineral soil and not surrounded mainly by leaf-litter or humus. Failure to observe this precaution may result in high transplant mortality if even a short period of hot, dry weather occurs during the first two to three weeks after planting .

Recommendations Regarding Types of Crop for Use in Conversion

ARABLE CROPS

(a) Food Crops.

Of all the food crops which may be grown on old wattle land, maize is likely to be the most profitable. Experiments at Bloemendal have shown that good maize yields can be expected for at least three years after stumping without the need for adding nitrogenous fertilizer to the normal dressing of 300 lb. of superphosphate and 150 lb. of muriate of potash per acre. The inclusion of potash is important, since it appears that supplies of this element in wattle soils are rather rapidly depleted by field crops.

Other food crops which should be successful are grain sorghums and ground nuts in rainfall areas between 30 and 35 inches, and oats, cow peas, soya beans, and swedes in areas with rainfall over 35 inches. Potatoes can also be grown successfully in old wattle land where the eelworm population has been reduced as a result of the practice of non-burning of brushwood over at least two cycles of wattle. In view of the introduction of reduced quota allocations in the sugar industry, growers are advised not to convert to sugar cane.

(b) Fibre Crops.

The fibre crop which appears most likely to prove successful in wattle growing areas is New Zealand flax or hemp (*Phormium tenax*). This plant requires a minimum rainfall of 35 inches for successful growth and should grow successfully on old wattle land if the soil is reasonably well-drained. It will tolerate light frosts, but is unlikely to be successful at altitudes much over 3,000 feet. The cost of establishing the crop is high and will amount to at least R40 per acre, including the cost of plants. It is important, therefore, to secure plants of a good strain, since some strains are higher-yielding than others.

The first yield is normally obtained in the fifth year after planting, and three further cuttings may usually be made at four-yearly intervals thereafter before the crop need be ploughed and replanted. The current price of *Phormium* fibre is R120 per ton, and an average yield of between $\frac{3}{4}$ and 1 ton of fibre per acre per annum can be expected when the plantations are in cycle. Processing costs are very high and the nett return is unlikely to exceed R30 per acre. The present annual production of *Phormium* fibre in the Republic is less than 1,000 tons and there is an estimated potential market for around 15,000 tons per annum. A fair acreage has been put down to the crop in various

parts of the Republic within the last year or two, however, and prospective growers would be well advised to investigate future marketing prospects with care before embarking upon large-scale planting.

Other fibre crops which may be worth trying in certain areas are sisal and kenaf (stokroos). Suitable conditions for the former are most likely to be found in wattle areas at relatively low altitude along the Natal coast and areas inland which are frost-free and have an annual rainfall below 35 inches. The average cost of establishment of this crop is around R50 per acre and average yields of about ½ ton of fibre per acre can be expected annually for about five years, beginning in the fourth year from planting. The current price of sisal fibre is about R140 per ton, but it is difficult at present to estimate the potential market, and growers considering conversion to this crop would do well to consult one of the manufacturing firms using sisal fibre.

Kenaf is likely to grow successfully in the Transvaal middle-veld, the Natal south coast, and parts of the Natal midlands in areas where the annual rainfall exceeds 38 inches. The plant is extremely sensitive to eelworm, however, and may not succeed on wattle land where brushwood has previously been regularly burnt. Production costs amount to about R40 per acre, and an average yield of about 1 ton of lint per acre can be expected. The current f.o.r. price of good quality, well-baled lint is about R80 per ton.

PASTURES

In wattle-growing areas with an annual rainfall in excess of 35 inches, and especially where perennial streams make possible the use of spray-irrigation, conversion of wattle land to pastures either for beef or fat lamb production would appear to offer excellent prospects of success.

In the drier areas, with rainfall between 33 and 37 inches, weeping love-grass (*Eragrostis curvula*) should give satisfactory results on old wattle land. In a trial at Bloemendal, this grass has yielded 5 tons or more of dry hay per acre in each of the last two seasons on land which had carried only one ten-year crop of wattle after having been abandoned as arable land owing to poor maize yields. In areas with rainfall between 37 and 40 inches, Rhodes grass should prove a suitable pasture species at lower altitudes and should be used in preference to *E. curvula* wherever it will provide a permanent stand. Finally, in areas with rainfall over 40 inches, kikuyu grass will probably prove the most suitable species for pastures on wattle land, though grasses indigenous to a particular locality, such as *Paspalum*, should also be tried.

ORCHARD CROPS

The orchard crops most likely to give successful results in wattle-growing areas are pecan nuts and fruits such as citrus and avocados. Papaws might also be grown on a small scale in areas which are not subject to frost.

Pecan nuts will grow well on relatively heavy soils provided these are reasonably deep. The trees are planted at 60′ by 60′ espacement and must be kept free from weeds by regular hoeing or disc-harrowing. Until they reach a large size, however, it is permissible to grow crops between the rows, preferably legumes such as cowpeas, which may either be cut for hay or grazed. Care must be taken when selecting high-yielding varieties to ensure that they are also scab-resistant, since this disease is prevalent in mist-belt areas. The variety "Mataffin" is probably the most suitable for the moister and the varieties "Bester" and "Moore" for the drier parts of the wattle-growing area. Budded pecans will usually come into bearing at about 6 years of age, and by 10 years should produce up to 30 lb. of nuts per tree. Production will generally continue to increase thereafter and should exceed 50 lb. of nuts per tree after 15 years of age. The present demand for nuts is excellent and the current price is about 30 cents per lb.

The best returns for citrus are obtained on the export market, which is normally supplied from orchards in relatively low rainfall areas. In the higher rainfall of the mist-belt, however, there is opportunity for production of oranges on a limited scale for supply to local markets. The Washington navel is to be preferred for this purpose, since it enjoys a local popularity, ripens later than the more commonly planted Valencia, and is also less subject than the latter to the black-spot disease.

Avocados will usually do well at altitudes between 2,500 and 3,500 feet in areas with rainfall in excess of 35 inches. They prefer the deep, well-drained, doleritic soils which are frequently found in the mist-belt, and should not be planted in areas where there is risk of severe frosts. The "Fuerte" variety is recommended, as it withstands moderate frosts and comes into production at a time of year when there is virtually no competition from other varieties on overseas markets. Budded trees should be planted at an espacement of 40′ by 40′, and will normally come into bearing at 4 to 5 years of age and reach full production at about ten. Wattle-growing areas in the Natal midlands are favourably situated for the export of avocados, and present indications are that better returns will be obtained by exporting than by selling on local markets.

Small-scale production of papaws to supply local markets during February, March, and April, when prices are highest, may prove very profitable on frost-free sites where soils are deep and well-drained. The plants are set out at an espacement of 8′ by 2′ and are thinned by removing most of the male trees as soon as flowering has begun and the sexes can be distinguished. A suitable ratio of male to female trees is 1:8, and to secure out of season production, all fruits which set up to mid-March are removed, while flowers opening after this time are hand-pollinated to improve the rate of setting. The quality of fruit produced by this method is superior to that of early or mid-season fruit, and prices obtained for it may be three times as high.

FOREST CROPS

These comprise tree crops grown for the production of saw-timber, poles, mining timber, and pulpwood, as well as minor forest products.

(a) Saw-Timber Production.

Pines may be grown for this purpose on a wide range of sites and are particularly suitable for planting in areas where frost makes re-establishment of wattle difficult. *P. patula* prefers the deeper soils on cool, moist sites and should not be planted at altitudes below 3,000 feet. *P. elliottii*, on the other hand, is more adaptable and will grow moderately well even on heavy soils and on fairly hot aspects, while it may be planted from altitudes as high as 4,500 feet down to sea level. It is, however, slower-growing and produces a lower yield of timber than *P. patula*. Pines grown for timber should be planted at 9′ x 7′ espacement to secure adequate selection for straightness in the final crop.

There are indications of a developing market for eucalypt saw-timber, but prospective growers should investigate future prospects carefully before embarking on large-scale planting for this purpose. The only eucalypt species really suitable for saw-log production is Saligna gum (*E. grandis*) and plantings for this purpose should be confined to deep, well-drained soils on sites which are not subject to severe frosts and where the average annual rainfall is in excess of 35 inches. The trees should be planted at 9′ x 9′ espacement and must be thinned and pruned at regular intervals if large-sized timber of good quality is to be obtained.

(b) Pole Crops.

Among the eucalypt species which are favoured for the production of creosote-treated telephone and transmission poles, a number can be found which will grow satisfactorily on some of the range of sites which occur within the wattle-growing areas. Thus, *E. paniculata* and *E. cloeziana* prefer frost-free sites with a rainfall in excess of

35 inches, *E. grandis* will withstand light frosts and may be grown successfully on sites with a rainfall as low as 30 inches, provided there is reasonable depth of soil, and species such as *E. fraxinoides* and *E. scabra* give promise of satisfactory pole production in frosty areas at altitudes over 4,000 feet.

Eucalyptus grown for pole production may be planted at 8′ x 8′ or 9′ x 9′ espacement and, according to the nature of the site and the species used, may be worked on rotations ranging from 7 to 15 years.

The market for telephone and transmission poles is relatively limited, and growers intending to go in for production of this type of material would do well to secure contracts in advance with firms undertaking creosote treatment.

(c) Mining Timber Production.

E. grandis is the eucalypt species most widely used for the production of mine poles and packs, but in frosty areas where it cannot be grown successfully, *E. fastigata*, *E. smithii*, and straight-growing strains of *E. lindleyana* should be planted to supply this market.

(d) Pulpwood Crops.

Both pine and *E. grandis* provide the raw material for pulping processes. Pine is used mainly for the production of newsprint and unbleached papers and in admixture with wattle and gum for the production of bleached papers, while Saligna gum is used in the manufacture of rayon pulp and various types of hardboard.

When grown exclusively for pulp production, pines should be planted at 9′ x 7′ or 7′ x 7′ espacement, but *E. grandis* will probably give the best yield at 8′ x 8′ espacement on rotations up to 10 years.

(e) Minor Products.

Certain eucalypt species are being grown in the Republic at present for the production of essential oils and there may be scope for expansion of this enterprise if suitable species can be found.

In general, the eucalypt species which produce the highest yields of essential oil are also rather cold-resistant. The cooler parts of the wattle-growing areas, therefore, should be favourably situated for oil production, and growers in these areas would do well to investigate the possibilities of essential oil production. Eucalypt species which are recognised in Australia as good oil-yielders and which are known to grow satisfactorily in the colder wattle-growing areas are *E. dives*, *E. radiata*, *E. smithii*, *E. lindleyana*, *E. macarthuri*, *E. oreades*, and *E. cinerea*. Other species, not commonly grown in South Africa, which might also be tested for oil production in the colder areas are *E. fraxinoides*, *E. delegatensis*, *E. andrewsii*, *E. camphora*, *E. obliqua*, and, if seed can be obtained from Australia, *E. fruticetorum*.

PUBLICATIONS, 1960-1961

Anon .. .. *The Wattle Research Institute Report for 1959-1960* (*Thirteenth Year*). Pietermaritzburg, The Wattle Research Institute, October, 1960.

Anon .. .. L. L. J. Ossowski. *Rep. Wattle Res. Inst. for 1959–1960* (1960), pp. 6–8.

Gordon-Gray, C. G. and Jones, R. A. The Significance of Sub-standard Bark in the Production of Wattle Extract. *Rep. Wattle Res. Inst. for 1959–1960* (1960), pp. 39–43.

Moffett, A. A. and Nixon, K. M. Induced Tetraploidy in Black Wattle (*Acacia mearnsii* De Wild.). *Rep. Wattle Res. Inst. for 1959–1960* (1960), pp. 32–38.

Ossowski (the late) L. L. J. and Wortmann, G. B. Notes on Wattle Insects Observed during the Period 1959–1960. *Rep. Wattle Res. Inst. for 1959–1960* (1960), pp. 44–47.

Ossowski (the late) L. L. J. A Virus Disease in the Biological Control of the Wattle Bagworm. *Rep. Seventh Comm. Ent. Conf., London,* 1960, pp. 118–122.

Shaw, H. and Sherry, S. P. The Wattle Industry in the Union. *Handbk. for Farmers in S. Afr.* Vol. I, pp. 163–178. Pretoria, Dep. Agric.

Shaw, H. .. .. .. L. L. J. Ossowski. *J. Ins. Pathol.,* 1961, **3**, pp. 226–229.

Sherry, S. P. .. .. Live Pruning of *Pinus patula* and *P. elliottii* in South Africa. *J. S. Afr. For. Ass.,* 1961, **No. 36**, pp. 18–22.

Sherry, S. P. .. .. Experimental Measurement of Run-off and Soil Erosion in Wattle Plantations in Natal. *Proc. Third Int.-Afr. Soils Conf., Dalaba,* 1959 (1961), Vol. I, pp. 677–683.

Printed by THE NATAL WITNESS (PTY) LTD., *Pietermaritzburg.*